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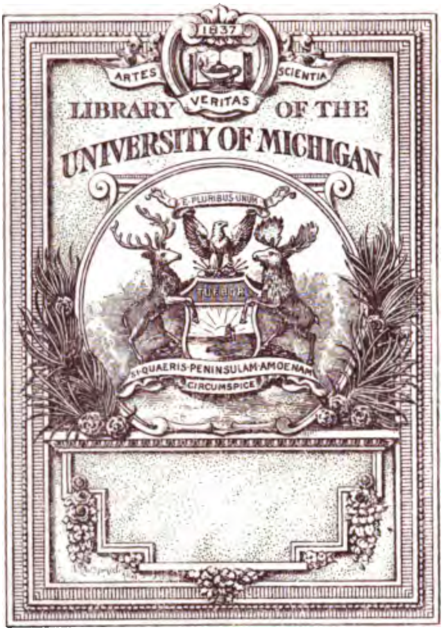

THE GIFT OF
Mrs. I. Russell

F. S. CRAWFORD,
BINDER,
CONCORD, N. H.

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FIRST ANNUAL REPORT

UPON THE

GEOLOGY AND MINERALOGY

OF THE

STATE OF NEW HAMPSHIRE,

BY

C. H. HITCHCOCK,

State Geologist and Hall Professor of Geology and Mineralogy in Dartmouth College.

MANCHESTER:
JOHN B. CLARKE, STATE PRINTER.
1869.

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Office of the Secretary of State,
Concord, New Hampshire, June 4, 1869.

Sir,—By virtue of authority vested in me by a Resolution which passed the House of Representatives and was concurred in by the Senate on the 3d inst., I hereby authorize you to print fifteen hundred copies of the Report of the State Geologist for the use of the State.

J. D. LYMAN,
Secretary of State.

John B. Clarke, *State Printer.*

REPORT OF THE STATE GEOLOGIST.

Hon. John D. Lyman, Secretary of State:

Respected Sir, — The Act * establishing the Geological and Mineralogical Survey of New Hampshire provides that the Geologist "shall make a brief annual report of his progress to the Secretary of State," reserving for the final report the principal portion of the details. In accordance therewith I have the honor to present you a brief sketch of the results already obtained by your Geologist.

On the eighth of September last I had the honor to receive from his Excellency the Governor the notice of my appointment as State Geologist. Conceiving that the interests of the state would be best served by an examination of the new Ammonoosuc Gold Field, I started at once for Lisbon, Grafton county. I found it important to stop on the way at Hanover, in order to arrange with the authorities of the Agricultural College for a working room, which might serve both for an office and storage apartment until a place should be prepared for the exhibition of the specimens of rocks, minerals and soils collected in the field. I reached Lisbon Sept. 12, and spent the remainder of the season — nearly two months — in attempting to unravel the intricate

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*** Chapter III of the Laws of the State of New Hampshire, passed at the June Session, 1868.**

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structure of the auriferous formations, and in making a hurried reconnoissance of the west and north parts of Coös county. As a part of our work, invitations were issued through all the newspapers of the state, to persons interested in minerals, to communicate information and forward specimens of interesting and valuable substances for examination. About fifty answers have been received to this appeal, communicating many facts of great importance, as well as specimens. The great success of this circular has satisfied us that the community will watch the progress of our work with much interest, and that those who have been living among the rocks and hills of New Hampshire will not be satisfied with the economical results of the survey, but are anxious to understand the causes of the elevation of the mountains, of the immense foldings and erosions of the solid ledges, the filling of the rock crevices with metallic ores, and the formation of the soils.

As soon as possible our corps of observers was organized by the appointment of George L. Vose, of Paris, Me., and J. H. Huntington, of Norwich, Conn., as Assistant Geologists, and of Prof. E. W. Dimond, of Hanover, as Chemist.

Unforeseen circumstances prevented either of the geologists from entering the field last fall, but the untiring industry and energy with which they have taken hold of the work the present season bear witness to their ability, and indicate that the hidden structure of the rock formations must soon reveal itself to their view. It seems best to give each of them a special subject, or a definite area to investigate. Accordingly the White Mountain region has been assigned to Mr Vose, and the principal part of Coös county to Mr. Huntington. Both are now engaged in their districts. Mr. Vose will pay special attention to the topography, and, in addition to the delineation of the geological structure, has engaged to furnish the most accurate map of the mountain region ever drawn.

Besides the two principal field assistants, there will be several volunteers in various parts of the state, receiving no compensation, and working for irregular periods; whose labors will be duly reported and credited after their completion. Special arrangements have been made with Prof. Dimond, of the Agricultural College, to analyze whatever specimens of rocks, soils and ores may be sent to him from time to time. Inasmuch as his working apparatus has not been in order the past winter, some thirty or forty determinations have been made for us by Prof. Charles A. Seely, of New York, American editor of the "Chemical News."

The work of the present season was commenced by myself, April 28, a few days having been devoted to procuring a suitable outfit. On the third of May, Messrs. Vose and Huntington joined me at Lisbon, and since that time we have been busily engaged in determining the distribution of the veins, and the limits of the gold field in the towns of Littleton, Lyman, Lisbon, Monroe, Bath, Landaff and Haverhill. We have intended to devote unusual attention to this area, on account of its importance, — more time and labor, perhaps, than may be possible in most of our territory.

Except by large maps it is difficult to give the general reader an adequate idea of the labor requisite to trace out the intricate windings and disturbances of the strata. Where rocks have scarcely been disturbed since their deposition, large plateaus, occupying often hundreds of square miles, present themselves to view, and it is only necessary to explore the valleys that have been excavated out of the edges of the table lands, in order to determine their character. But in a mountainous region like New Hampshire not only has the primitive plateau character been destroyed, and the strata tilted up at every angle, but the original sedimentary layers have been altered, the fossils which indicated their relative age have been obliterated, the proper succession has been obscured by unequal upthrows and downthrows, mountain masses have been inverted; and, if by a judicious course of induction a reasonable theory is propounded to explain the difficulties, it is necessary to follow the course of the bands out of the state into a fossiliferous region in order to ascertain their true age. In this report the attempt is made to determine the proper succession and equivalency of the constituents of the Ammonoosuc Gold Field; some of the larger curves and zigzag courses, accompanied by extensive faults, have been delineated upon a map; and from a considerable acquaintance with the geology of the neighboring states and province we have ventured — we hope not prematurely — to correlate the series with the "talcose schist" of Vermont, and the "Quebec Group" of Canada. A large manuscript map of a portion of the towns of Bath and Lyman has been prepared, and will be sent to you with the specimens designed to illustrate the whole series.

THE AMMONOOSUC GOLD FIELD.

Under the appellation of *Ammonoosuc Gold Field*, is included the territory occupied by the auriferous slates and schists along Connecticut river, supposed to belong to the Quebec Group of the Lower Silurian, lying mostly in New Hampshire, but partly in Vermont, and possibly extending beyond the sources of the Connecticut into Maine and Canada. The southern limit is near Bellows Falls. Explorations in this field have been desultory and disconnected. The earliest discovery of free gold in any part of it, so far as can be ascertained, was made by Mr. Hanshet, in Plainfield, not later than 1854. This was but a short time before Moses Durkee, of Lebanon, washed gold out of alluvium in both Lebanon and Hanover. In the report upon the

Geology of Vermont,[*] published in 1861, Springfield, Vt., is given as a gold locality. It was obtained from the gravel and but a short time previous, according to my notebook. No other proof of the presence of gold in the Connecticut valley is cited in that report, though its existence there is "strongly suspected."[†] In 1858, while acting as assistant on the Vermont survey, I measured a section from Lake Champlain over Camel's Hump and Mount Washington, which crossed this auriferous field in Littleton.[‡] The similarity of the ledges to those in the great talcose schist and gold-bearing formation just east of the Green Mountains led us to regard them as of the same age and character. In my report upon the Geology of Maine I have described the supposed continuation of this formation as probably auriferous; and it may be connected with the gold rocks upon the Upper Chaudière and St. Francis rivers of Canada, described by Sir W. E. Logan, and said to have yielded masses of gold weighing a hundred and twenty-six pennyweights.[§]

The first discovery of gold in Lyman was made by Dr. John Torrey, of New York, in August, 1864. He made an assay of several specimens of galena collected by Prof. Henry Wurtz from the orchard vein of the New Hampshire Silver Lead Company. The third sample submitted to Dr. Torrey contained silver at the rate of 56.95 ounces, and gold at the rate of 1.006 ounces to the ton of two thousand pounds. Prof. Wurtz visited the locality and the neighborhood in July and September, 1864, and in December, 1866. His reports were issued by the Silver Lead Company in 1864, and subsequently he prepared for the American

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[*] Page 683.

[†] Page 849.

[‡] id. p. 521.

[§] Geological Survey of Canada,—Report of Progress from its Commencement to 1863, p. 437.

Journal of Mining* a full account of his connection with the discovery, and suggested very appropriately that the whole auriferous district be called the Ammonoosuc Gold Field, as it is drained by the Ammonoosuc river and its tributaries. He remarks of the Lyman district that the "history of this gold field presents, probably for the first time, the peculiarities of a first discovery in the *solid rock*, and not, as usual, by the tracing up of gulch gold to its home in the lodes." The appropriateness of the name, coming from so high an authority as Professor Wurtz, leads us to extend it over the whole area of the group in New Hampshire and Vermont.

In 1865 both J. Henry Allen and Charles Knapp, independently of each other, discovered free gold on the David Atwood estate in Lisbon. This led to the organization of the Lisbon Gold Mining Company, on the twenty-eighth of February, 1866, with a nominal capital of $240,000. Previously to this organization a little work, or "prospecting," had been done, and subsequently three considerable excavations were made in the vein. The first is in a swampy piece of land on George brook. This has been sunk to the depth of ninety-four feet, the first thirty-five vertical, and the remainder inclined at an angle of forty-five degrees or more, upon the supposed dip. It is said that a dike of trap is connected with the vein in the foot-wall as low as fifty feet. The greatest amount of free gold showed itself within twenty feet from the surface. The gangue of the vein is quartz, about one-twentieth part being composed of magnetic iron pyrites or pyrrotite, with a slight sprinkling of yellow copper pyrites or chalcopyrite. The assays of the rock were said to indicate at least $60 to the ton. It is probable that the pyrrotite contains gold, as the best specimens show free gold intermingled with it. It is estimated by good authority that about three hundred dollars have been obtained practically by milling from this mine.

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* Sept. 12, 1868.

The second opening, a few rods up the hill on the south bank, was sunk thirty feet. The third, much farther south, was sunk twenty feet. All the openings indicate a vein over four feet in thickness, similar to that already described, and bounded by a hard quartzite resembling gneiss. The vein is about an eighth of a mile removed from a clay slate.

The company were not very successful in extracting the gold from this mine, and ceased to excavate in December, 1866, allowing the opening to become filled with water. They then bought one half of what is now known as the Dodge Mine, and since the abandonment of the first, have wrought the second diligently. Their capital stock has been reduced to $48,000.

THE DODGE MINE.

In June, 1866, Mr. J. H. Barratt, while laboring on the Dodge farm, in Lyman, nearly two miles by road from Lisbon village, discovered a stone projecting from the wall which contained a yellow substance resembling gold. The specimen was sent down to S. K. Fisk, of Lisbon, who pronounced the yellow mineral iron pyrites; but upon cleaning the other face of the stone discovered a large sprinkling of gold, the finest specimen ever found in New Hampshire. This discovery led to a search for the vein. Three or four shallow openings were made, and an association formed to work one half the property, known as the Dodge Gold Mining Company, with a nominal capital of $75,000. The Lisbon and Dodge Companies have worked this mine jointly since the early part of 1868, each transporting its share of quartz to the mills at Lisbon village. The Dodge Mill commenced operations March 12, 1868, on the north side of the river. Each mill has ten stamps, and is capable of crushing and amalgamating eight tons in twenty-four hours. It is unnecessary to specify the various changes made in the management of the mine and the mills, the subleases, or the various improvements in the machinery since the commencement of the work. Such changes are incident to every mining enterprise, and are often beneficial, but they render it difficult to ascertain the precise amount of gold that has been separated from the quartz. By dint of diligent inquiry of the several persons who have taken charge of the returns, it is clear that not less than $16,000 gold value has been taken from the Dodge Mine the past three years, all of which has been coined and passed into the monetary circulation of the world. I have the pleasure of forwarding to you with this report several specimens of the native gold, the quartz rock, of coin manufactured from it, and a gilded model to show how much space is occupied by the metal taken out of the Dodge property by these two mills.

In describing the Dodge vein, let me call your attention to its position on the map accompanying this report. It is situated upon an irregular band of clay slate, which commences on the south in Bath, and extends uninterruptedly, though tortuously, into the north part of Littleton. This rock may be called the "country" of this variety of vein, and therefore, wherever its area extends, even in neighboring towns, we have a given territory in which we may expect to find similar veins. In fact, our note-books contain notices of several of these veins, often where no one has suspected their existence.

The principal opening, or the *shaft*, on the Dodge property is in the south part of the farm, about six hundred feet S. 20° E. from the western border of the formation. The vein is chiefly a whitish quartz, often glassy, characterized by masses of slate, crystals of pyrites, ankerite* and galena scattered through it. The quartz often displays spangles of clear gold, commonly adjoining slaty fragments. By assays of the general average of the vein, and of each constituent separately, except the galena which is very rare, we have endeavored to show in what part of the mass the gold probably exists. According to Prof. Seely's determinations, the average mass of the vein, or the several constituents mixed in the natural proportions, yields gold at the rate of $18.90 per ton. The clear quartz yields $18.11; the pyrites in the slate and in the quartz yield a very small amount, not enough to be weighed in the sample assayed, the former containing the most; and there was none in the ankerite or slate. If it is allowable to generalize from these single determinations, it were easy to say that ninety-nine hundredths of the gold came from the clear quartz. The ankerite and galena characterize the vein mineralogically; insomuch that every quartz lead, over the whole clay-slate area which displays these minerals, must be considered as worthy of exploration and trial in the mill for gold. All who own lands over that area may find this hint of service to them.

The gold of this district seems to be nearly pure. One of the returns from the Government Assay Office gave nine hundred dollars of gold, and four and a half of silver, or half of one per cent. of silver. This is even purer than the Nova Scotia gold, which contains from two to eight per cent. That from California averages one and two-tenths per cent.; from Australia four-tenths to one per cent., while the Chaudiére gold of Canada, or that nearest Lisbon, contains from ten to fifteen per cent. of silver.

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*This mineral, otherwise known in the books as Bitter Spar, is a lime-carbonate, but does not always effervesce with acids. It may be known by its facility of decomposition, leaving behind iron-rust, and by its softness when compared with the quartz. A specimen from this neighborhood contained 27.24 per cent. of carbonate of protoxide of iron, 58.25 per cent. of carbonate of lime, 13.51 per cent. of carbonate of magnesia (by difference), and one per cent. of silica. Specific gravity of crystal examined 3.008. The mineral differs from dolomite in having greater weight, and over ten per cent. of carbonate of iron.

The Dodge shaft was sunk seventeen feet in 1867, and the rock taken from it yielded $6.25 per ton in the mill. After that the whole vein on both sides was excavated for a length of several rods to the same depth, the rock yielding only $3.00 or $4.00 per ton. After the return to sinking the original shaft, $10 per ton was obtained immediately, and the yield from that moment has never been less, averaging $14, and in one instance reaching $19. The shaft has been excavated to the depth of about seventy feet, and there are drifts at about sixty feet depth in both directions, particularly to the east. The rock from the greatest depth seems to have been the most productive. It is probable that not less than one-fourth or one-fifth of the total amount of gold present in the vein has been lost in the milling process, so that the actual results obtained do not fairly represent the true value of the rock.

OTHER GOLD MINING PROPERTIES.

A great many properties in the town of Lyman have been regarded as auriferous. Most of the earlier explorers have abandoned their openings, and in none of them has the amount of work done been considerable. I will mention specially the Grafton Gold Mining Company, the Pittsburgh Company, the Williams Company, Bedel property, and the New Hampshire.

The Grafton Gold Mining Company, organized since last fall, is near the west corner of Lyman. It was known first as the Davis and Thayer, and afterwards as the Wiggin and Davis property. I visited it Sept. 14, and May 10. It lies in the western aluminous (talcose) schist division of the

Gold Field, the rock being dolomitic and somewhat slaty. At the surface three veins, each about a foot in width, showed themselves, with narrow slaty partings, which became smaller at twenty-five feet, and are said to have entirely disappeared at the depth of seventy-six feet,—the bottom of the shaft,—and to be eight feet wide. The veins incline southeasterly 55° at the surface, and ten degrees less at the depth of twenty-five feet, the lowest point at which I have seen it. The vein is of limpid quartz with many crystals of quartz, dolomite or ankerite, iron pyrites and galena, besides some free gold, — the latter most abundant in the upper vein. An immense number of segregated quartz veins ramify through the dolomitic mass that is brought to the surface.

From several assays shown me by officers of the company, it appears that the earlier assays gave over $7.00 of gold to the ton of rock, and at the depth of seventy-six feet, out of a mass weighing fifty pounds, Dr. Torrey of New York obtained gold at the rate of $62.17 to the ton, and of silver, $1.33. An examination of the pyrites showed no gold present. About forty per cent. of the gangue was shown to be of quartz, and the balance chiefly dolomitic. A careful examination of a similar sample by T. C. Raymond of Cambridgeport, Mass., gave the following result: silica, 30.3; protoxide of iron, 6.27; lime, 20.6; magnesia, 11.17; carbonic acid, 32.11; total, 100.45. This composition leads the company to believe that the pulverized rock may be used advantageously as a fertilizer after the extraction of the gold, and some experiments have been instituted to show its value.

The Pittsburgh Company own the minerals upon the Henry Ash farm in Bath, and the J. Dow farm in Lyman, adjacent to each other. Several promising openings have been made upon the first mentioned, showing a vein possessing the mineral characters of the Dodge rock mentioned above, from four to twelve inches thick. Only a few feet distant from the first is a quartz lead four feet thick, both being in the clay slate. The Dow ledge is a peculiar conglomerate ; the same with the next.

The Williams property lies adjacent to the preceding, higher up on Smith brook. At the house of J. Williams, a ledge of quartzose conglomerate crops out by the roadside, perhaps forty feet high and of equal thickness. This ledge, two hundred and eighty-two feet in length, is one outcrop of a very interesting division of the gold rocks, whose windings and faultings have been carefully studied by us and represented upon both our maps. It is an ancient gravel, now consolidated, but it is not known whether the gold was deposited in the original placer or introduced in small veins at the subsequent period of elevation. The company's statement represents that assays of from six to eight hundred pounds of rock have given them from five to seven dollars* of gold to the ton, and on account of the facility with which thousands of tons can be obtained from the mass, think that an average yield at these rates would be remunerative. The whole width is traversed by segregated veins, in which pyrites and ankerite are abundant, while specks of galena and copper have been seen. This company own a very fine water privilege on the Ammonoosuc a mile and a half below Lisbon, where a dam has been thrown across the river, and they propose to erect very soon a large mill with improved machinery, both for amalgamating gold and concentrating copper ores. The Grafton and Pittsburg companies also propose to erect steam mills for the same purpose in the neighborhood of their mines.

The New Hampshire Gold Mining Company (office at Keene), own a property east of the Dodge mine in a band of whitish schist. The vein is mostly a clear yellowish quartz carrying a little pyrites. It is eight feet wide, and an opening has been made twenty-five feet deep. Hon. S. W. Hale of Keene has shown us a piece of gold taken from five hundred pounds of this rock, said to be worth twenty-eight dollars. This is one of the most constant of the quartz leads of the country, as it shows itself upon the Clough and Titus farms to the southwest.

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* In one ease, $9.99 in currency. The latest experiment shows $3 per ton.

Quite recently the uncovering of a small vein two feet wide upon the Bedel farm in Lyman, high up the northeast slope of the Smith Brook valley, has excited great interest. No opening in the whole region has shown so many fine specimens of free gold with such little exertion. I panned out several pieces of gold in a shovelful of earth from the top of the ground, and saw much richer yields in the hands of others. It has become a possession of the Williams Company, and will probably be thoroughly explored the present season. Its mineral characters ally it partly with the Grafton, and partly with the Dodge vein. A recent determination gives $12 to the ton.

Time fails us to speak of twenty other properties in the neighborhood, whose development would undoubtedly lead to the discovery of openings as valuable as any of those mentioned. The continued success of those now being milled will gradually bring the best of them into notice.

WILL IT PAY TO MINE FOR GOLD IN NEW HAMPSHIRE?

The question now naturally arises, Can any of the gold veins in New Hampshire be wrought advantageously, so that capitalists need not fear to invest their funds here? The most satisfactory answer may be obtained by comparing the facts presented with those derived from actual remunerative working in a well known gold-producing country. Let us examine the returns from the Quartz

Mills of California in 1861, as given in the very careful report of Professor Ashburner in the first volume of the Report upon the Geology of California.* All the statistics relative to the machinery, number of stamps, power of each stamp, amount of fuel and mercury consumed with each ton, the cost of the several parts of the stamping process, etc., of thirty-eight different mills, are there presented. The lowest yield reported was $5.00, and the highest, $80.00; but the average was $22.87 per ton. The least total cost of milling is reported at 67 cents, the highest $8.31, while the average was $2.49 per ton. The table does not include the cost of mining.

Taking now the actual results at Lisbon, we reach conclusions that are quite hopeful. It costs $4.00 per ton or thereabouts to deliver the rock at the mill, and about the same to extract the gold. The average practical yield after the enterprise had fairly started has been $14.00 to the ton. Thus we find that while the yield is less and the cost of milling greater than in the average of California quartz, the New Hampshire rock may be classed within the limits of what are considered good mines on the Pacific slope; and further encouragement is derived from the probability that the cost of milling and mining may be reduced over one hundred per cent. when the business has passed beyond the limits of infancy. These veins are certainly worthy the attention of those who wish to invest in quartz mining.

In regard to the auriferous conglomerate, or the rock yielding less than the Dodge veins, it may be said that there is need of further experiment before reaching a decision as to its value. It is very remarkable that there should be such an enormous amount of this rock, always showing some gold. Assays upon samples near its northern limits showed gold at the rate of $0.75 and $0.90 per ton — further south about $3.00 by Professor Seely's determinations; and at the Williams mine as high as $7.00. Further systematic trials of this rock are recommended.

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* Later returns than these have been published by Professor Whitney, but these will enable us to form a just comparison.

GEOLOGICAL MAP.

With this report I enclose a colored Geological Map of the most interesting part of the Ammonoosuc Gold Field. The scale is too small to show many interesting features; but this imperfection may be remedied in part by an enlarged map of a portion of the area, sent in manuscript, and designed to be hung upon the wall near the specimens I have sent on to illustrate our resources. The subdivisions of the formation proposed for these rocks may be regarded as provisional and liable to amendment after further explorations shall have made our knowledge more definite.

There are two general divisions shown upon the map, first the granitic and gneissic rocks, which appear to be older and consequently to underlie the formations of the second or Quebec group — the true auriferous strata. The name Quebec is that applied by Sir W. E. Logan, of Canada, to rocks supposed to be of the same age in the Provinces of Quebec and Newfoundland, partly fossiliferous, and thus shown to constitute a new group, not present in the New York series, but lying between the Calciferous Sandrock and the Chazy Limestone of that classic ground. In Canada the lowest member is composed of limestone and black shale, over six thousand feet in thickness, and known as the *Levis* series. The middle layers, or the Lauzon group, resemble the lower schist of the Ammonoosuc field, and are extremely variable in thickness, sometimes one hundred and sometimes four thousand feet. It is the copper-bearing rock of Canada, having a magnesian band, either a dolomite, soapstone or serpentine at its base. The rocks include also many bright red and green slates. The upper divison, or the *Sillery sandstone*, is often calcareous and conglomeratic, with a second magnesian band at its base. It also contains copper. Our subdivision is triple, but it is impossible at present to define in our territory the strata peculiar to either the Levis, Lauzon, or Sillery.

A mere glance at the map and accompanying section suggests two conclusions: First, there is an unusual expansion of the area occupied by the gold rocks north of Haverhill, which contracts to some extent in the latitude of Littleton. The narrowest part of the group can be seen by referring to the Vermont Geological Map, and noticing the contracted band, not three miles wide, along Connecticut river. It is not over four miles wide in any part of its course between Lebanon and Woodville.

Second, the rocks assume the form of a basin or synclinal axis.* To confirm this view, appeal is made to the general arrangement of the several groups. In the center is the auriferous conglomerate, with some of the upper schists. These are enclosed by a line of dolomite not represented upon the map; this by clay slate; the slate by the lower green schists which occupy the outer edge of the basin, and adjoin the gneissic rocks of the White Mountains upon the east, and the calciferous mica schist or supposed Upper Silurian strata on the west in Vermont. Hence the strata in the center of the field, the conglomerate, slates and upper schists, lie at the summit of the series, and were the latest formed. A few words about each sub-division.

1. *Gneissic and Granitic.* These rocks consist of gneiss passing into mica schist and granite. They continue easterly from the gold field past the White Mountains

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* Shown also further north — *Geology of Vermont, p.* 521.

into Maine. By way of geographical convenience, they may be called the White Mountain series. The line of union is irregular, and the bordering rock is not uniform. In Littleton it is generally granitic; in Lisbon, gneissic; more quartzose in Haverhill. A bed of limestone skirts the border in Lisbon, and its place seems to be taken by soapstone in North Haverhill.

2. *Staurolite Rock.* Adjoining the gneiss, and apparently resting upon it, is a slate or schist (according to locality) filled with crystals of the mineral *staurolite*, called *staurotide* in the older mineralogies. Garnets are also present. This rock has not been seen out of Lisbon and Landaff, and that which lies in Landaff is chiefly garnetiferous. More labor is required to fix the limits and proper relations of this rock. At almost any outcrop good specimens of staurolite may be obtained in abundance.

3. Next are *argillaceous schists*, passing into clay slate. This rock differs from clay slate further west, and receives no color on the map to separate it from the next division. A line drawn from the south branch of the Ammonoosuc in Lisbon to the east line of Bath shows its western border. It may contain garnets and staurolite, and carries quartz veins worthy of examination for gold.

4. *Lower Schists.* These belong to the lower part of the Quebec group. They are chiefly a greenish, unctuous schist, sometimes massive, the same with that usually called "talcose schist." As the unctuous character seems to be derived from the alumina present, we shall often style them aluminous schists. Marked varieties occur over the wide area representing this division, as hornblende and chlorite schist, greenish quartzites, sandstones and conglomerates, white quartz, etc. Within it are beds of dolomite, limestone, buhrstone, the copper belt, and veins of iron pyrites. It would seem as if there was an anticlinal axis in the west part of the area of this group, followed by a synclinal in the east.

5. *Clay Slate.* This rock is abundant in the central part of the series, and carries the gold veins akin to the Dodge lead. That which lies in Bath is often grayish. Its distribution is quite irregular, and there are several patches of it, apparently outliers, in two of which are slate quarries. The dolomite next the conglomerate is frequently imbedded in this dark slate. In the more northern part of the dolomite, the rock is more schistose.

6. *Auriferous Conglomerate.* An immense number of facts of scientific interest in regard to this curious belt have been obtained, but their publication must be deferred. The rock is a clear quartz conglomerate, from ten to one hundred feet wide, extending from the east part of Lyman into Bath. As it can be readily recognized and resists decomposition, it furnishes an excellent landmark by which one can discover the wonderful foldings, overturns and dislocations in the strata. Instead of following a straight course, its line of outcrop is sharply tortuous, and a fault has often thrown the rock out of its line, in one case a distance of eleven hundred feet. These variations are shown in the large manuscript map spoken of above, and on the printed map as well as the scale will permit, by the red line. That this rock overlies the slate is shown by the general synclinal character of the country, but its encirclement by the clay slate which both accommodates itself to the very tortuous course in Bath and dips beneath it on the east, south and west sides. That it overlies the lower schists seems proved by the presence in it of pebbles of quartz containing chlorite, jasper and buhrstone, all of which have been observed exclusively in that member.

7. *Upper Schists.* These are partly very light colored, and partly quite siliceous as well as unctuous. They bound the clay slate on the west side, near the Dodge Mine, while near their eastern limit is the valuable auriferous quartz vein described as the property of the New Hampshire

Mining Company. The color and aspect of this group change in proceeding southerly.

8. *The Copper belt.* This will be described in detail in the following pages.

In the absence of exact information respecting the distribution of the bands of dolomite in this district, it will be useless to refer any of these minor members either to the Levis, Lauzon or Sillery formation. It may be added to this description, that the Quebec group extends westerly only to the line drawn on the map. A narrow belt of clay slate lies next to it, and beyond is the calciferous mica schist,both altogether within the limits of Vermont.

It should be added that in the preparation of this map much assistance was given by Messrs. Vose and Huntington — the former by his facility with the pencil, and the latter by his visits to particular points, in order to determine the limits of several of the subdivisions. To him is due the credit of distinguishing the staurolite rock from the argillaceous division west and the gneissic east.

COPPER ORES.

One of the colors on our map represents a band of rock charged with the yellow sulphuret of copper. It flanks both slopes of Gardner's Mountain, a high range between Bath and Littleton. The rock is generally an aluminous or micaceous schist charged with numerous patches and masses of both copper and iron pyrites. The precise width of the belt, the number of veins, and the irregularities to be expected in their distribution, have not yet been mapped. Numerous openings have been made upon both sides of the mountain, and a brief description of the most important of them will now be attempted, beginning at the southwest limit and proceeding northeasterly.

Near the Bath north line is an excavation several feet deep, made some time since. It is said there are two veins here, one crossing the other at right angles. The cross vein varies in width from four to eighteen inches at the surface. This is the Lang property.

Next, in the town of Lyman, are two localities of interest. The first is on the Grafton Gold Company's land, from which I have seen many good specimens, and the second adjoins the land of the New Hampshire Silver Lead Company. Several openings have been made, showing two or three veins well charged with copper pyrites, each three or four feet wide.

The New Hampshire Silver Lead Company is organized under the laws of the State of New York, with a nominal capital of $500,000. Professor Wurtz has made a report upon this property, from which the following information is taken. There are two groups of veins, called the West Lodes and the Orchard Veins, the former cupreous, the latter of lead and silver. The west group consist of three "heavy quartz outcrops," one of them ten feet wide, containing numerous strings and bunches of galena, with copper pyrites, gossans and honey-combed cavities, including "*vugs*," or cavities lined with crystals of quartz, rarely containing indigo copper. It was traced three or four hundred yards in length. The schists adjacent are greatly stained and incrusted with limonite, or iron ore, indicating a highly metalliferous condition for the country.

The second, or Orchard Group of veins, consist of two, each about two feet wide, and apparently true fissure veins, with the compass course N. 50° E. They contain chiefly galena and zincblende. The quartz is "comby," carrying much gossan; and the walls, which near the surface are very rotten, become hard and quartzose several feet down, and well charged with iron pyrites. Several assays of the different galenas have been made by Dr. Torrey, and the results tabulated by Professor Wurtz as follows. He supposes the galena to contain only 80 per cent. of pure lead, allowing for impurities, and the ton is taken at its full value of 2240 pounds.

In one Ton of Galena from	Ounces of Silver.	Ounces of Gold.	Value of Silver in coin.	Value of Gold in coin.	Total.
West Lode, dark,	55.877		$72 24		$180 00
West Lode light,	35.716		46 18		154 00
Mean of West Lode,	45.798		59 21		167 00
Orchard Vein,	51.027	0.9014	65 98	$18 63	192 50
Mean of the three,	47.540		61 43		175 50

An adit has been driven 300 feet into the hill to drain the west lodes. As soon as work is resumed upon this property it will be carefully examined.

The next is called the Osgood Mine, embracing about 700 acres of the land on the east slope of Gardner's Mountain. I examined four or five openings. The first, near the south line, was ten feet deep, exhibiting five feet width of copper schists. The second shows a width of ten feet of copper schists. The third is a shaft thirty-five feet deep. Eighty feet below is a short tunnel eighty feet long, and designed to cut the vein. A large pile of good specimens of this copper may be seen near the shaft.

The next north is called the Oro Mine. Here is a shaft sixty-five feet deep, a shaft house, easily seen from a great distance on account of its conspicuous position, two drifts fourteen and sixteen feet long, and a vein from four to seven feet wide, carrying more ore near the hanging than the foot wall. Sixty tons, part yielding 10.80 and part 9.+ per cent. of copper, have been shipped from the mine to Boston. There are one hundred and seventy-five acres of land connected with this property, and the vein is eighty-eight rods long. The mining has been conducted by Capt. Nason of Lisbon.

Not less than three other copper properties were examined to the north of the Oro in Lyman—the Stevens and Nason, Locke, and Swan and Garland. All show excavations a few feet in depth, a mixture of the usual iron and copper pyrites in the schist several feet wide, but they exhibit no features requiring a detailed description.

The only copper opening on the eastern belt in Littleton is at Mr. Little's, near the town line. A shaft eighteen and a half feet deep has been sunk in the center of a mass of copper-bearing schist forty feet wide. The richest portion of this mass is a vein six or seven inches wide, which at the bottom of the shaft has expanded to nearly three feet in average width. The general appearance of this property reminds one of the rock worked near Lennoxville, P. Q., known as the Clark Mine. On the Little estate the vein must extend for 150 rods, and the surface descends rapidly to the Connecticut river; so that a fine opportunity is here presented for the excavation of an adit along the course of the vein, which will both drain the shaft above and prove the value of the rock for a considerable distance.

A mile or two east from Little's is the White Mountain Copper Mine. No copper property in this region has been so thoroughly explored as this; several buildings have been erected for shaft-house, whim, dressing-sheds, etc., and the main shaft has been sunk to the depth of one hundred feet. It was impossible for me to examine the character of the rock below the surface, as all the excavations were filled with water; but, judging from external appearances, the vein must be from six to eight feet wide, composed of white quartz with copper sulphuret, iron pyrites, chlorite and ankerite disseminated abundantly through it. On account of the contrast in colors, very beautiful hand specimens may be obtained here. The location is a poor one so far as drainage is concerned. I found no one who could say why the mine had been abandoned, or whether it was the intention to resume work again in the future. The company was organized under the laws of the state of New York.

Returning to the Gardner Mountain region, the first mining locality seen on the western copper belt, beginning at the northern end, is at S. J. Albee's, adjoining the south line of Littleton, less than a mile west of the Little Mine. A comparison of the dips of the strata in the two belts makes it probable that they are the same, upon opposite sides of an anticlinal (possibly synclinal) axis. See the section on our map, which crosses Gardner's Mountain. On Albee's land several openings have been made, in one case twenty feet deep. There seems to be a sprinkling of copper in the schist for a width of thirty feet, and near the lower edge of the cupreous rock is a solid mass of iron and copper pyrites, three feet wide, the former mineral predominating. These features are promising for a good mine. The Cornish miners prefer to see the iron pyrites or "mundic" very abundant at the surface, knowing by experience that the copper pyrites gradually takes its place according to the depth of the excavations. Our observation satisfies us that this rule holds as good in North America as in Cornwall.

There are several small openings along the western belt in Munroe, the most important of which is on the Fairbanks property on the "Bald Ledge" mountain. The best part of the copper schist is six feet wide, containing in addition to the usual minerals, zincblende and obliquely crossing veins of quartz. The shaft-house is very high up, so that the vein could be well drained to a considerable depth.

In Littleton and Dalton are two openings, showing the purple and gray ores of copper. One is on Wheeler Hill, and the other is known as the Dalton Mine, where work has been performed under the direction of J. B. Sumner, Esq. The rock of the country is clay slate, but the gangue of the vein is a species of talcose schist, containing a little yellow copper and minute particles of magnetic iron. The walls of the Dalton Mine are very distinct, about sixteen feet apart. The gangue is traversed by cross veins of quartz, often carrying fine specimens of the purple ore, or *Bornite.* A shaft has been sunk about twenty-five feet deep upon the vein, and a few openings have been made as far as 200 or 300 feet north of the shaft-house, sufficiently to prove the continuation of the vein. Similar proof exists of the presence of copper—perhaps the same vein—half a mile in the other direction. This property is upon the top of a hill. It is conveniently situated with reference to water-power, being near the Connecticut and one of its tributaries, so that the ore taken from the mine could very easily be concentrated at slight expense. An average sample of the whole vein sent by Mr. Sumner gave to Professor Seely 5.4 per cent. of metallic copper. Should the whole vein yield as well, this mine can be worked to advantage.

In brief, it may be said of the Gardner Mountain range of copper veins, that they consist of schists charged with the sulphurets of iron and copper, averaging less than five per cent. before concentration; that they are conveniently situated with respect to drainage and to water-power. As several mines are contiguous, adits, mills and tramways might be constructed for the mutual benefit of all the proprietors, with a comparatively small proportionate outlay for each. It is understood that some of these proprietors have already arranged for the concentration of the ores at the new mills soon to be constructed in the west corner of Lisbon, and that the work of excavation will be speedily resumed at the mountain. The working of these copper veins, if conducted with prudence and wisdom, will undoubtedly be remunerative; and when the enterprise is fairly inaugurated, a large number of workmen will be employed and a new impetus given to the industry of the whole community.

ZINC MINE AT WARREN.

The Warren Zinc Mine is now under the skillful management of Capt. Edgar. It has been known for twenty years as a copper mine, but as the vein has been followed downwards, the zinc has to a considerable extent increased at the expense of the copper, and it is for the zinc chiefly that the mine is now wrought. The principal vein is of quartz, ten feet wide, crossed by a mass of the mineral tremolite. The hanging wall is a sandstone, the foot wall micaceous slate. To the depth of twenty-five feet, copper ore and galena predominated. Below that point, to the bottom of the excavation, one hundred and fifty feet, the zinc is the most abundant, amounting to one-half. At the bottom the vein is twenty feet wide, and there is a drift one hundred and eighty feet in length. There seems to be a "pipe" or "chimney" of pure ore in the vein, sometimes fifteen feet thick and twenty feet broad, which is the most valuable part of the metallic sheet. It does not proceed on the direct line of the dip, but passes down about ten degrees from it.

At present the ore is sent first to the Lowell Bleaching Company, Mass., where the sulphur is removed and converted into sulphuric acid. The residue then goes to Bethlehem, Pa., where it is smelted into spelter. The sulphur brings $12 per ton of ore, and the residue $28 at Bethlehem, while the freight charges amount to $10.50. Until recently the ore was roasted in piles at the mine, and no profit realized from the sulphur. Recently it has been determined that this zinc ore contains about $60 to the ton of gold. If this can be saved after the utilization of the sulphur and zinc, it is evident that the value of the ore will be more than doubled. If the means were furnished to separate the sulphur, zinc and gold at the mines, a large sum would be saved that is now expended for transportation.*

It may be proper to add that superb specimens of zinc and galena have been sent us from the Carroll County Silver Lead Mine, in Madison. It is said that the vein is of large dimensions, and gives promise of abundant success to those who are working it.

SLATE.

The discovery of clay slate in New Hampshire suitable for roofing and marbleizing is quite recent, and to us surprising, as it is not mentioned in any work upon the rocks or minerals of New Hampshire. It is found in considerable amount along Connecticut river, and not less than four quarries of it have been visited. Three of them are in Littleton. Of these, those belonging to Richard Smith and Mr. Bachelder are in the north part of the town, in immediate juxtaposition. The band of rock suitable for being worked is nearly an eighth of a mile wide, and the principal opening has been excavated to the depth of about twenty or twenty-five feet. Mr. Bachelder's quarry lies farther away from the road than Mr. Smith's, and more labor has been expended upon it. Both are well situated for working, as the strata stand upon their edges, and a deep cut on the course of the slate would both drain the quarries and present a surface for working over a hundred feet high. The rock appears to be entirely free from pyrites, but it cannot be split so finely as that quarried in Maine, though it cleaves sufficiently well for practical purposes.

Another quarry has been opened by a company, about two miles westerly from Littleton village. It lies upon a high hill facing Connecticut river. A fine opening has been made on the course of the strata, N. 80° E., about two hundred feet long and fifty feet deep, and in a cross-cut leading across the layers there is a tramway. Several houses have been built for occupation by the workmen, and everything has been calculated for substantial work. Much of the rock taken out contains pyrites, but I am assured by some of the proprietors that there is in the opening a broad band of rock entirely free from this impurity. In other respects this slate is excellent. The map shows these quarries to lie in the same geological horizon, though on two different outliers.

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* Mr. Huntington has just returned from an exploration of this zinc mine, and has prepared a large diagram to illustrate the course of the vein, and its relation to other veins of quartz and dikes of trap. It has been received too late for insertion in this report.

Excellent specimens of slate have been shown me from Piermont, and in Hanover and Lebanon a wide area is occupied by the same rock. The Moose Mountain and Lebanon slate companies have been incorporated by legislative enactment, the first in Hanover and the second in Lebanon. The first named company has not yet done any work, but the second has expended over $25,000 upon its quarry and mill. A visit to this interesting locality, and inquiries of the proprietors in respect to the cost of opening, etc., have resulted in the following statements. The property consists of one hundred acres of land, about one hundred rods in length along the course of the slate, with a fine water-power and mill, adjoining the track of the Northern Railroad. The company was organized July 4, 1866, and has now expended about $4,000 in opening its quarry, where is presented to view a vertical face about fifty-five feet broad and deep. I saw slabs fully fifteen feet square, and others can be obtained even larger. The bed of valuable slate is not less than thirty feet thick; what its length may be was not determined. The mill is about a quarter of a mile from the quarry, upon Mascomy river, forty-four feet wide, sixty-five feet long, and three stories high. It contains machinery driven by water-power, put in at an expense of $8,000, requiring the services of twenty workmen when fully equipped. The slate is very soft and does not split into shingles suitable for roofing, but is used for the manufacture of chimney-pieces, table-tops, shelves, etc., which are marbleized by a secret process, the same as that for a long time in successful operation in western Vermont. Without this polish the rock is manufactured into sinks, cisterns, burial cases, flooring, etc., and the waste is ground and bolted into *slate flour*, of which the company have sold about one hundred and fifty tons the past year. The company find ready sale for their goods at a fair profit. Their courage in the face of the many difficulties incident to a new enterprise merits an extensive patronage, and nothing except numerous orders for the articles manufactured is required to establish the business upon a lasting foundation.

It is probable that other excellent opportunities exist in the state for the quarrying of slate for roofing and manufacturing, but it will require further field-work to make them known.

AGRICULTURAL VALUE OF LAND IN COOS COUNTY.

My trip through northern Coös county brought to light an interesting geological reason for the fertility of the soil about Colebrook and its vicinity. In the Report upon the Geology of Vermont, it is stated that the superior agricultural character of certain towns in the eastern part of the state, from Guilford to Derby, is due to a particular rock formation beneath the surface. The ledges are composed of alternations of bluish siliceous limestone, clay slate and mica schist, which, by the action of the air, rain and frost, readily decompose, and the lime and other fertile ingredients are leached out and diffused through the soil, where the roots of the growing crops can readily assimilate them.

Statistics can be prepared, showing that the farms lying upon this belt of land through Windsor, Windham, Orange, Caledonia and Orleans counties, produce more in proportion to their inhabitants and valuation than the other farms east of the Green Mountain summits, and this solely on account of the character of the ledges beneath the soil.

Not expecting to see this calcareous formation in New Hampshire, I was agreeably surprised to discover in the towns of Columbia, Colebrook, Stewartstown and Clarksville the familiar features of this old acquaintance. This region is characterized by the presence of dome-shaped hills, generally covered by soil and by the marked absence of boulders. The ledges are mostly concealed, since their outcrops have rapidly disintegrated and disappeared. The boundaries of this formation will be accurately fixed the present summer, and it is possible they may lead us into the forest region of the northern part of the state.

It may be interesting to compare the agricultural statistics of a county where this calciferous rock predominates with one where gneiss or granite prevails. I have chosen Caledonia in Vermont and Worcester in Massachusetts as representatives of them. The first, according to the last census, produces annually 814,007 bushels of wheat, rye, corn, oats, pease, beans, potatoes, barley and buckwheat, or an average of thirty-seven and a half bushels of these products to every inhabitant. Worcester county produces annually 1,634,012 bushels of the same articles, or an average of ten and a half bushels to each inhabitant. Caledonia shows nine improved acres to every inhabitant, and over two-thirds of the land has been cultivated. Worcester shows three acres of improved land to every inhabitant and nearly one-half its area has been cultivated. The older county of Worcester, therefore, is behind her younger sister in the proportionate amount of the agricultural products of the improved lands, and in the susceptibility of the soil to improvement,—since the larger population in the greater area has less proportionate cultivated area than the less population in the smaller area. There may be other reasons to explain the difference between the products of these two districts, but the margin is certainly ample to illustrate our position that the country of the calcareous rocks is better adapted for agricultural purposes than the gneissic and granitic. There is reason to believe that our explorations will bring to light other fertile areas of this description in New Hampshire.

PEAT.

A few specimens of peat have been sent to me for examination. On account of the importance of this substance for a fertilizer and its abundance in the state, it seems best that a special examination should be made, both of its value and extent. As practical benefits may result from this examination, the following statement and proposal are commended to the consideration of the farmers.

Peat is the vegetable soil of bogs and swamps, and consists of the debris of decomposed aquatic or marsh plants. That formed from moss is of the best quality, and is most abundant in granitic and siliceous regions like New Hampshire. Muck is peaty matter mixed with soil, and is consequently less valuable than true peat. Peat *ripens* with age or advancement in decomposition, and is then comparatively heavy and dense, and appears pitchy. When ripest it is most valuable.

Peat often makes a good fuel and a valuable fertilizer. It absorbs and retains water and ammonia, promotes the disintegration of the rocks, renders light soils more productive by its application, and acts as a direct fertilizer.

Professor S. W. Johnson, who has paid great attention to the subject of peat, and has compared its fertilizing properties with those of ordinary stable manures, finds that "peat contains, in a given quantity, about one-third more organic matter, an equal amount of lime and nitrogen, but is deficient in potash, magnesia, phosphoric and sulphuric acids."

These deficiencies may be remedied by adding to one hundred pounds of fresh peat one pound of commercial potash, or five pounds of unleached wood ashes, one pound of good superphosphate, or one pound each of bone-dust and plaster-of-Paris.

In view of the small amount and the cheapness of the materials to be added to peat to make it equal to stable-manure, it seems as if the farms of New Hampshire might be greatly enriched at a very small expense. But as the peat of various localities will require different degrees of amendment, there should be a chemical examination before it can be said what additions ought to be made. I have, therefore, made special arrangements with Professor Dimond to furnish such analyses at a small price, for all who may send on about a cubic foot of the peat to be examined, with statements as to its extent and thickness. The general results of these examinations will be stated in future reports. Those who may choose to avail themselves of this opportunity will receive, upon application to Professor Dimond or myself, a circular giving more particular directions. A few dozen analyses of peat from all parts of the state would probably enable us to form generalizations of great value to the community, while these results could not be obtained without help from individuals in the way indicated.

LIMESTONE.

Many persons have inquired if it is not possible to find beds of limestone, particularly in the northern part of the state, suitable for the manufacture of a first quality of quicklime. Several localities have been visited. That capable of producing the finest quality is in Columbia, at Lime pond. Here is a deposit of white marl, made by the slow accumulation of the shells of molluscous animals, apparently underlying about half the area of the pond. Some crude attempts were made formerly to burn it. It would be necessary to drain the pond, in order to get ready access to the marl. This would not be difficult. I have seen very fine lime manufactured from a similar marl in Vermont.

There are several quarries of limestone in East Lisbon and East Haverhill, and not less than two kilns in active operation. We have examined Orrin Brownson's kiln only. He manufactures annually about 2,200 casks. Mr. Mason, of Haverhill, does a large business in the same direction. A specimen from his quarry resembles the limestone at Thomaston, in Maine. That from Mr. Brownson's and three or four other localities in the east part of Lisbon holds the same geological position,—all are in the gneiss. It is generally represented that the lime from these quarries is equally strong with that imported from Maine and Vermont, while the mortar made from it is not pure white. Other beds of importance are in Littleton, near Parker brook and near a buhrstone. The East Haverhill bed is said to be four hundred feet wide. We find limestone mentioned as occurring at Lyme, Orford, Amherst, Warner, Plainfield and Cornish. There is no doubt that the state will furnish an abundance of lime suitable for common and agricultural purposes. Whether any can be found equal to the best brought in from other states cannot be determined without further examination.

OTHER FACTS.

I have collected facts about the production of the Francestown soapstone,—one of the finest quarries in the United States,—the mica of Grafton, the quartz of Lyndeborough, feldspar, etc.; but reserve their presentation to you until I can visit the localities. There is a great abundance of mineral wealth in New Hampshire, sufficient to surprise any one who had never considered the subject.

For building materials, there are, first of all, the granite, for which the state is justly celebrated; also slate, flagstones, soapstone, limestone, and immense deposits of clay suitable for making bricks.

The substances useful in the arts are enamelled slate, quartz and feldspar for glass, mica, soapstone, fluorspar, plumbago, precious stones, polishing powder, moulding sand, and ochres for paints. For agricultural uses there are peat, marl, phosphate of lime, limestone and scythe-stones. For chemical and metallurgical uses there are the metals gold, silver, copper, lead, iron, tin, manganese, molybdenum, titanium, arsenic, and zinc; copperas, alum, and sulphurets for the extraction of sulphur.

It will be our aim fully to illustrate in the two collections ordered by the Legislature, these natural resources, as well as all the rocks and minerals interesting in a scientific point of view. Some suggestions in regard to one of these collections have been addressed to the President of the Agricultural College, and are presented to the Legislature in the report from that institution.

INTEREST IN THE SURVEY.

The interest felt by the people of the state in our survey has manifested itself very pleasantly in acts tending to forward our researches. Some hotel proprietors have refused to accept of compensation for accommodation received; others have reduced the ordinary rates for our benefit; many occupants of private houses have freely tendered their hospitalities; some have gone with us to point out localities of interest, and for six weeks so many carriages were placed at our disposal that there was no occasion to hire a team. Every one with whom we have come in contact, from highest to lowest, has expressed an interest in our work, and no one has spoken of it disparagingly. These many favors have greatly stimulated us in our work.

We cannot refrain from acknowledging publicly the important aid furnished by the newspapers. They promptly circulated our original appeal for aid, and have always been ready to help us subsequently.

The authorities of Dartmouth College have generously provided rooms to serve as an office and working apartment, as well as for the exhibition and storage of specimens till a building is erected for their accommodation.

Very material aid might be furnished us if the proprietors of large tracts of land would afford the means of exploring, more thoroughly than our funds will permit, the lands in which they are interested. An example worthy of imitation in this regard has been set by J. B. Sumner, Esq., of Dalton, who has kindly offered us everything needful for a minute examination of the township in which he resides. Such surveys are of the greatest importance in the unsettled districts, and where the presence of valuable minerals is suspected.

Last but not least is the assistance furnished by the railroads. Free passes have been courteously tendered by the superintendents of the C. & P. R.R., Vt. C. R.R., Vt. V., Vt. & Mass., N. L. N. R.R., Cheshire and Ashuelot R.R.'s, B. C. & M., N. R.R. and branches, Concord R.R., M. and L. R.R., and the Boston, Lowell and Nashua, the latter by the manager. In three instances my assistants have received the same favor.

Respectfully submitted.

C. H. HITCHCOCK.

Hanover, June 3, 1869.

SECOND ANNUAL REPORT

UPON THE

GEOLOGY AND MINERALOGY

OF THE

STATE OF NEW HAMPSHIRE.

BY

C. H. HITCHCOCK, PH. D.,

STATE GEOLOGIST AND HALL PROFESSOR OF GEOLOGY AND MINERALOGY
IN DARTMOUTH COLLEGE.

MANCHESTER:
JOHN B. CLARKE, STATE PRINTER.
1870.

REPORT OF STATE GEOLOGIST.

HON. JOHN D. LYMAN, *Secretary of State:*

RESPECTED SIR,—The Act * establishing the Geological and Mineralogical Survey of New Hampshire provides that the Geologist "shall make a brief annual report of his progress to the Secretary of State," reserving for the final report the principal portion of the details. In accordance therewith I have the honor to present you a brief sketch of the progress made in the work since the first of June, 1869.

The work performed the past year may be embraced under two heads—*Topographical* and *Geological.* As soon as your geologist entered upon his duties he began to study the character of the maps in use, that he might learn with how great precision the position and courses of the several mineral veins and rock deposits could be delineated. He found that a map had been issued under the authority of the State in 1816, by Philip Carrigain. This seems to have been a very fair delineation of the natural and civil boundaries at the time of its appearance. But there are serious errors in it of latitude and longitude. Nearly half the boundary lines have since been altered, whether of the towns or the limits between adjoining territories, and moreover, the plates are not to be found. Then the whole face of the country has been altered since 1816; large tracts of forest have been reclaimed and occupied by village sites, numerous roads and railroads have been constructed, so that Carrigain's map does not meet the necessities of either practical or scientific purposes at the present day. There have been smaller maps, also, constructed, most of which are inferior to Carrigain's for accuracy, as they certainly are in the style of execution.

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* Chapter III of the Laws of the State of New Hampshire, passed at the June Session, 1868.

Besides this, other map material exists. There are, first, the county maps, prepared chiefly by Prof. H. F. Walling, at an expense of over $20,000. These present the roads with great accuracy, and likewise the names of the owners of every house at the time of the surveys. Being on a large scale and published mostly about 1860, the boundaries and names agree essentially with what they are at present, and the surveys were quite accurate. Secondly, a considerable triangulation has been effected by the United States Coast Survey, over fully a third part of the state. By means of these triangles a score or more points are definitely fixed in respect to latitude and longitude, and that as correctly as is possible, through the unequaled accuracy of the Coast Survey engineers. Thirdly, there exists a very careful delineation of the boundary between New Hampshire and Canada, prepared in 1844, under the direction of the government of the United States of America and Great Britain, Colonel Graham being the Commissioner on the part of the United States. Lastly, there are the reports of commissioners concerning the boundaries between New Hampshire and Maine, between New Hampshire and Massachusetts, and there are two local maps of the White Mountain region, all of which are accessible.

On further inquiry it was ascertained that in 1853 the Legislature appointed a commissioner to report upon the expediency of preparing a new topographical map of the state. The report was presented the following year by

Prof. John S. Woodman, of Hanover, who briefly recited the errors in Carrigain's and other maps, and carefully estimated the expense of preparing a new draft based upon the government work just alluded to, and upon new surveys. He showed that such a map would involve an expense of thirty or forty thousand dollars. No action was taken upon this report by the Legislature.

It appeared to your geologist that the chief part of the surveys requisite for the proper delineation of a new map of the state had been made since 1854, so that by a careful collation of the abundant material, coupled with some additional triangulation and river surveys, a new map might be prepared, sufficiently accurate for all practical purposes, which would require a very small appropriation compared with the sum estimated by the commissioner in 1854. A letter was accordingly addressed to His Excellency the Governor, and the Honorable Council, in which the foregoing facts were recited, and the proposal was made that, without asking for any additional appropriations, the geologist would cause a new map of the state, upon the scale of two and a half miles to the inch, to be prepared, and that this work might be considered as involved in the act authorizing the survey. The Council approved of this proposition May 13, 1869, and your geologist has, since that time, taken measures to prepare the map, in connection with his other work.

The work performed in this department has been the following: The latitude and longitude of six points have been determined with great accuracy by Professor E. T. Quimby, of Hanover. He used for this purpose a very fine theodolite belonging to the Thayer Department of Dartmouth College, having a plate of thirteen inches diameter, and six heliotropes kindly lent by the United States Coast Survey. He followed the system of triangulation adopted by the Coast Survey, and found it necessary only to measure angles, using for a base line the accurately determined distance between Mount Monadnock and Uncanoonuc. The following are the latitudes and longitudes obtained by Professor Quimby, and the accompanying map shows their positions when protracted, with the lines composing the triangles.

Mount Monadnock, Jaffrey, lat. 42 deg., 51 min., 39.611 sec.; long. 72 deg., 6 min., 30.489 sec.

Uncanoonuc, Goffstown, lat. 42 deg., 58 min., 58.338 sec.; long. 71 deg., 35 min., 18.825 sec.

Mount Kearsarge, Warner line, lat. 43 deg., 22 min., 58.53 sec.; long. 71 deg., 51 min., 27.81 sec.

Mount Ascutney, Windsor, Vt., lat. 43 deg., 26 min., 45.39 sec.; long. 72 deg., 27 min., 8.42 sec.

Shattuck Observatory, Dartmouth College, lat. 43 deg., 42 min., 17.22 sec.; long. 72 deg., 17 min., 9.99 sec.

Moose Mountain, Hanover, lat. 43 deg., 44 min., 2.972 sec.; long. 72 deg., 8 min., 29.7 sec.

The bearings of numerous villages and prominent points from these several stations were also taken, which will aid materially in constructing the map. The precise location of the stations is fixed by driving a metallic bolt into the ledges. As illustrating the accuracy of Professor Quimby's work, it may be said that the results prove themselves. For example, the position of Mount Ascutney, as calculated by the line direct from Monadnock, differs only two inches as calculated from those by way of Uncanoonuc and Kearsarge. This difference has been averaged in the figures given above.

Mr. George L. Vose spent a few weeks among the White Mountains and took a large number of observations for the purpose of fixing the exact position of as many of the high mountain peaks as possible. The place of Mount Washington had been fixed by the Coast Survey,—those determined by Mr. Vose are the following, and they are shown also upon the accompanying map:

Mount Passaconnaway, Waterville; Mount Kiarsarge, Chatham; Mount Whiteface, Waterville; Mount Chocorua, Albany; Mount Washington.

The other points attended to by Mr. Vose are very important. He has taken accurate sketches of the outlines of all the mountains in the horizon as seen from Chocorua and Kiarsarge. The instrument used was a six-inch theodolite obligingly loaned for the purpose by the United States Coast Survey.

During the past few months Prof. C. A. Young, of Hanover, has been engaged in determining the longitude of the Shattuck Observatory by means of astronomical observations. The telegraph was brought into requisition, connecting the Dartmouth with the Cambridge Observatory in Massachusetts. The results are not yet fully worked out, but they scarcely differ from those determined trigonometrically by Prof. Quimby. Indeed, on account of a station error, it is probable that the latter are the most reliable.

During the past season all of us have been supplied with the county maps in our travels throughout the state, and we have had occasion to test their value, and have carefully noted every change in the roads or position of prominent points for the purpose of correcting the general map to be compiled from them. The most important corrections are those made by Mr. Huntington during his careful journeyings, on foot over six hundred and seventy square miles of the forests in northern Cöos county, even to the Crown Monument. The streams and mountains there are very erroneously depicted, and it is doubtful whether truthful delineations of that very remote region can be acquired except by more thorough engineering work than our means will permit.

For the sake of determining the formations in the Ammoonusuc Gold Field with accuracy, we have commenced a topographical survey of a few square miles of the most valuable portion upon the scale of five hundred feet to the inch. With the aid of J. H. Huntington, A. C. Page, of Centre Harbor, and A. A. Woolson, of Lisbon, two square miles of the territory have been surveyed. The intention is to set stakes at the corners of every block of five hundred feet square, and thus to locate the formations with great definiteness. If some aid were furnished us by the land-owners we could fill in the boundaries of their possessions, and thus show at a glance where valuable veins passed along. This information should perhaps be classed under the head of Geology rather than Topography.

One of our latest expeditions has been a trip by Mr. Huntington to determine the relative altitudes of the passes across the main range of the White Mountain range, in order to be satisfied which is the most feasible for either a common or steam railroad. The following are the passes through the White Mountain Range:

In Albany, head of Swift river into Mad river, Waterville, or into sources of the Pemigewasset.

Notch south of Carrigain.

Notch north of Mount Carrigain, between Sawyer's river and Pemigewasset, estimated at 1,700 feet. *Vose.*

Willey Notch.

White Mountain Notch, 1,920 feet. *Guyot.*

An examination west of the Pemigewasset showed that the pass between Woodstock and North Benton is very low. Hence a feasible route exists for a railroad either up the Swift river or Sawyer's river valleys to Woodstock, and thence by way of North Benton to Wells River.

THE STATE MAP.

It thus appears that the material already accumulated for the preparation of a new state map is abundant, and can be usefully employed. One other point remains to be mentioned. The most important and valuable of all this material is not public property. The county maps are copyrighted, and the courses of the roads could not be copied from them without violating the laws of the State and United States. Your geologist has conferred with the proprietor of the copyrights, and finds that very reasonable terms can be made with him for the privilege of copying the roads and other valuable features.

Supposing that all this material is at our service, your geologist is prepared to recommend that measures be taken immediately, at the present session of the Legislature, to cause a new map of the state to be engraved on copper, on the scale of two and a half miles to the inch, the plates to be the property of the state, and thus available hereafter as well as for immediate wants. We have drawn a map on this scale showing nearly all the physical features that can be engraved, which will be submitted to your inspection as well as to that of the Legislature. It has been prepared under the direction of Walling and Gray, experienced civil and topographical engineers, who have drawn and published several hundred county and state maps, including nearly all the county maps of New Hampshire. The scale is the same as that adopted upon the state maps of Vermont and Massachusetts, or those areas immediately contiguous to New Hampshire.

It is proposed to represent upon this map all the town, county and state boundaries; railroads and common roads; mountains, both isolated peaks and ranges; all the hydrographic features, as the rivers, lakes, ponds and valuable mill-sites; the names of the towns, locations, railroad stations, post-offices, villages, mines and quarries. The prominent cities and towns will be drawn upon a larger scale on the margin, as also a geological and possibly botanical and climatological maps.

HYDROGRAPHIC MAP.

At the request of the commissioners appointed to consider the propriety of establishing a survey of the water power of New Hampshire, we prepared a map of the state upon the scale of ten miles to the inch, showing by colors the areas drained respectively by the Connecticut, Androscoggin, Saco, Piscataqua, and Merrimack rivers. It was compiled from our data by Mr. Huntington. The map accompanies the Report of the Hydrographic Commissioners just published. A copy from the same plate, with changes and additions, is presented to you with this report, designed to illustrate the distribution of the granite and the progress of our triangulation, as well as some of the geological formations.

MEASURING HEIGHTS.

In order to understand the relations of the surface to the formations, it is desirable to know its general altitude above a fixed level, like the ocean. In such studies accuracy is very important. Hence it was thought best to determine with care one or more points far in the interior to serve as a basis for further operations. The first point selected was the cistern of the barometer at the Shattuck Observatory. A portion of the distance between this point and the ocean required to be leveled. This work was skillfully performed by Messrs. Frank and H. D. Woodbridge, of the Chandler Department of Dartmouth College. Between the Observatory and White River Junction the difference of elevation was found to be 234.473 feet; and between the center of Manchester depot and mean tide water at Great Bay, near Portsmouth, the difference was 180.832 feet. The following figures will therefore, by addition, express the altitude of the standard barometer above mean tide water:

Between Great Bay and Manchester	180.832
Between Manchester and Concord (information furnished by S. N. Bell, Esq., of Manchester,)	71.565
Between Concord and W. R. Junction (N. R. R. survey)	116.840
Between W. R. Junction and Observatory	234.473
	603.710 feet.

With this well established base the first point fixed among the mountains was Moosilauke. This mountain was occupied, chiefly for meteorological purposes, between December 20, 1869, and March 1, 1870, by J. H. Huntington and A. F. Clough, of Warren. About January 1, the barometer was broken accidentally. This was speedily replaced by another of superior construction, and for fifty days excellent observations were taken with it. These have been carefully compared with the observations taken at the same time at Hanover by Prof. C. A. Young, and by calculation the difference found to be 4,337 feet, thus making the entire elevation of the mountain above tide water to be 4,940 feet, or 150 feet higher than the figures given by Guyot. These results indicate probable errors in many of the figures given for the elevation of all the high mountains of New Hampshire. As important practical conclusions depend upon the accuracy of these determinations of altitude, too great care cannot be taken with their measurement.

WINTER OCCUPATION OF MOOSILAUKE.

A word about the Moosilauke expedition. It was designed and carried out by Mr. Huntington, chiefly at his own expense. Besides ascertaining the altitude by a prolonged series of observations, a matter desirable for other high mountains of New Hampshire, a determination was made of the average and extreme winter temperatures at the summit, of the force and direction of the wind, the ice formations were studied, and the question was settled of the possibility of spending the cold season comfortably at a high elevation, corresponding to the climate of Greenland. The results were of the highest possible practical and scientific interest, and will be published ere long in some scientific journal. No one can fail to commend the enterprise, energy and courage of Messrs. Huntington and Clough, and rejoice that the expedition was successful. The most striking of the phenomena, particularly a new form of ice deposits, were photographed by Mr. Clough, and can be studied stereoscopically.

It was found that the average temperature on the summit was several degrees lower than in the adjacent country, though on rare occasions it was colder below than above. February 22d was one of the coldest days, the average having been ten degrees below zero, and the lowest point seventeen. In other localities a lower degree was indicated. Hence the temperature is shown not to prevent the habitability of the high summits in the winter. The "terrible ice clouds" reported by sensational guides, and believed in by the credulous, were often penetrated without injury. But the winds were very powerful. A very accurate instrument for measuring its force or velocity—Robinson's Self-Registering Anemometer—was kindly loaned by the Smithsonian Institution, and its scale was read and recorded every day. The highest recorded velocity of the wind in New York City is at the rate of forty-five miles per hour. On the mountain it was rarely less than at the rate of seven miles per hour; while fifty, sixty, and even seventy, were not uncommon. The greatest velocity recorded was ninety-seven and one half miles per hour, which may not have represented the highest rate of the storm, on account of the impossibility of crawling to the instrument. The tables given in the books to use in the calculation of velocities do not exceed one hundred miles per hour, on account of its rarity. It is never exceeded, except in the most violent tornadoes or hurricanes.

I cannot refrain from quoting Mr. Huntington's account of this storm of the first and second of January last:

"January first and second were days long to be remembered. On the first the sun rose clear. We were above the clouds, and a grander spectacle one does not often behold. The clouds below seemed to roll and surge like the billows of the ocean. They were of every dark and brilliant hue—here resplendent with golden light, there of silver brightness—here of rosy tints, there of sombre gray—here of snowy whiteness, there of murky darkness—here gorgeous with the play of colors, there the livid light flashes deep down into the gulfs fashioned by the eddying mists. Above all these clouds, flashes of light and blackness of darkness, rise in stately grandeur the summit of Mount Washington, sublime in its canopy of snow; Lafayette, with its sharp ridges and deeply scored sides; while a few peaks of lower altitude glitter in the bright sunlight. But as the sun rises higher this picture melts away, and the whole country is flooded with light.

"This magnificence portended a storm. In the evening the wind changed from south to east, and increased in velocity. On the second, at 8 A. M., the falling snow changed to sleet, and the velocity of the wind was 70 miles per hour. At 9 it began to rain. At 12 there was a perfect tempest, the wind blew at the rate of ninety-seven and a half miles per hour. So great was the velocity that there was every probability that the anemometer would be blown away. But how to secure it now was a question. To stand against the fury of the gale was impossible. So my companion, a stout, athletic man, by lying down and clinging to the rocks, succeeded in getting it. When he reached the house he was thoroughly saturated, the wind having driven the rain through every garment, although they were of the heaviest material, as though they were made of the lightest fabric. During the afternoon the rain and the gale continued unabated. The rain was driven through every crack and crevice of the house, and so fierce was the draft of the stove, that the wind literally sucked out the fire, and it was with the greatest difficulty that we succeeded in re-kindling it. During the evening the wind seemed to increase in fury—nearly every glass that was exposed was broken by the pressure of the gale, although the window was somewhat protected by the snow and a ledge of rocks. As the lights were broken, the fire was again extinguished, and even my hurricane lantern was blown out, as quickly as if the flame had been unprotected. I spoke, but no one answered; I called louder but there was no response. I shouted but no answer came, and yet my companion was but a few feet distant. Darkness, if not terror, reigned.

"But our necessities quickly showed us what to do. By nailing boards across the window, and by the use of blankets we stopped the opening the wind had made. After 9 P. M., there were occasional lulls in the storm, and by 12 it had considerably abated, at least enough to bring on that depression that naturally succeeds a period of intense excitement, so we willingly yield ourselves to sleep, to dream of gentle zephyrs and sunny skies."

SECTIONS ACROSS THE STATE.

In the more strictly geological part of our work, much progress has been made during the past year. You may recollect that in a letter directed to Rev. Dr. Asa D. Smith, President of the New Hampshire College of Agriculture and the Mechanic Arts, and printed in their report for 1869, I set forth my views as to the best method of exhibiting the specimens of rocks collected during our exploration. It was suggested that these should be collected along lines about fifteen or twenty miles apart, running east and west, and parallel to one another. These lines were called lines of section, because it was proposed to show in connection with the specimens a geological profile and section. This method of studying the geological structure of the state readily commends itself to every mind, and it is gratifying to know that it also met the approval of some of the most distinguished geologists in the world.

We have crossed the state eight times in endeavoring to measure these sections. The lines of section thus measured are:—

I. From Lawrence, Mass., along the south border of the State to Connecticut river.
II. From Seabrook to Chesterfield.
III. From Portsmouth to Walpole.
IV. From Charlestown to Great Falls.
V. From Cornish to Milton.
VI. From Hanover to Effingham.
VII. From Stratford to Errol.
VIII. From Stewartstown to Atkinson and Gilmanton Academy Grant.

The two last were traversed by Mr. Huntington on foot, as they lie chiefly in the unbroken forest. Two sets of specimens along these routes have been collected, in accordance with the provisions of the Act establishing the survey. The presentation of the facts obtained is, by the same authority, reserved for the final report.

EXAMINATION OF COÖS COUNTY.

One of the most laborious parts of our work accomplished the past year has been the exploration of about six hundred and seventy square miles of territory in the north part of Coös county by Mr. Huntington. The country is mostly unsettled, and consequently traveling is restricted to the most primitive methods, and all supplies are carried on one's back. The same is true of all specimens collected, which are at least a thousand in number, from the forest region. But the information acquired has been most important; even the arrangement of the rocks there is better known than in any other part of the state of the same area. As will be seen by the map, the line has been clearly drawn between the White Mountain series of granitic or gneissic rocks and the dark slates and schists of newer formations. The latter are subdivided into eight different bands, and a county map has been colored to show them. Two matters of economical interest have been developed: the first, the existence of alluvial gold along Indian and Perry streams; and the second, the existence of large beds of serpentine north of Carlisle's Grant, a few miles southwest from the Crown Monument at the angle between New Hampshire, Maine, and the Province of Quebec. The latter is of course too remote to be available for the arts at present, though the time is coming when it will be used. The gold is not unlike that of Lyman judging from the character of the underlying rocks, but more closely resembles that mined a short distance over the line, where J. H. Pope, Member of Parliament, of Cookshire, Province of Quebec, has been profitably extracting gold by sluices, for two or three years past. Mr. Huntington's specimens are quite large pieces of shot gold not unlike that obtained by milling in Lyman. It is not unlikely that the gold can be profitably extracted both from the soil and the rock near the extreme northern boundary, and the proprietors of the large tracts of land there would do well to expend a few hundred dollars in testing the value of these auriferous deposits*.

The results obtained by Mr. Huntington, both practical and scientific, are embodied in a lengthy manuscript which will form a part of our final report. We spoke of the lime of Columbia and the superior agricultural character of the land generally in our report last year.

AGRICULTURAL DEDUCTIONS.

At the close of our remarks last year about the agricultural character of the lands overlying the calcareous formations, it was said, "there is reason to believe that our explorations will bring to light other fertile areas of this description in New Hampshire." Such discoveries were made even before the printing of the report was completed. The towns along the Connecticut river from Haverhill to Charlestown are largely underlaid by the same formation. It is best shown in Cornish and Claremont. Their superior value can be shown by statistics in the same way as before, if desired. The region where these lands may be sought for is that represented on our map west of the White Mountain series, along the Connecticut river. A knowledge of this fact may guide parties who wish to purchase farms in the most fertile locations; and it also illustrates the wisdom of the authorities in locating the State Agricultural College at Hanover. Let it be understood that this reference to fertile land relates chiefly to the upland soil, or that derived from underlying ledges close at hand, and not to the meadows which border all our principal streams.

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* The following extracts from Mr. Huntington's letters further illustrate the value of the gold :

"I have been for a few days on the Indian stream searching for gold, of which I send you samples. It is water-worn and may possibly have come from Canada in the drift."—August 11, 1869.

"I recently visited the gold deposits in Ditton, Province of Quebec. The location is about three and a half miles from the New Hampshire boundary at the head of Indian stream. The gold is obtained by the common process of washing [sluices]. The average yield is nearly ten dollars per day for each hand employed. The largest nuggets that have been obtained are worth one hundred and thirty-four dollars. The drift is like that on Indian stream, where I prospected. It contains a few more boulders of granite which, however, were not derived from the gold rocks. The rock at the washings is an argillaceous schist, the same with that between Hall and Indian streams."—October 4, 1869.

MAP OF DALTON.

It was stated in the first report that very material aid might be furnished us in our explorations, if the proprietors of large tracts of land would aid us in tracing out the formations upon lands in which they feel an interest. This appeal was immediately answered by J. B. Sumner, Esq., of Dalton, who furnished the means for a careful survey of the township of Dalton. The work was performed by Mr. Huntington, who prepared a map of the township, on the scale of one hundred and six rods to the inch, showing the several formations, as well as the courses of the metallic veins and the location of mineral deposits. A copy of this was sent to Mr. Sumner with an explanation of the signification of the several colors. We hope that this worthy example will be followed by others.

AMMONOOSUC GOLD FIELD.

In view of the prominence given to the gold of the state in the first report, some further notice may be expected of the same. After further examinations of the region, and that in a period of unparalleled inactivity at the mines, your geologist has seen no reason to change the views expressed concerning them previously. We have done much work there, but it is not yet ready for publication. The wonderful contortions and shiftings of the strata are beginning to be understood; the various veins are classified and traced through the country, and a map is in progress, which when completed will be much superior to the one already published.

Very little work has been done at the mines. Pecuniary difficulties have prevented the proprietors of the "Pioneer" of the country, the Dodge Mine, from executing their intention of putting their shaft in order, and none of the other proprietors are disposed to move except so far as they follow this leader. As the farmer needs his supply of buildings, implements and laborers before commencing his spring work, so these mining companies must have well-timbered shafts, apparatus for pumping water and elevating ores, with convenient mills. I am assured by the officers of the company that if these necessary pre-requisites were in their hands they would not be idle a moment. It is estimated that about two thousand dollars must be expended in this "dead work" before profitable mining can recommence. During the past spring the work was, however, resumed, though nothing was in progress at the time of my last visit, about the first of June.

A notice of this gold field was presented before the American Association for the Advancement of Science at their late meeting, in Salem, Mass. Professor Wurtz was present and suggested that the credit of the discovery of gold in the solid rock should not have been ascribed to Dr. John Torrey, who made the analysis under his direction, but to himself. Inasmuch as the specimens were assayed on account of the gold supposed to be present—that is, since the collector suspected the presence of the precious metal and instituted a search for it—the statement on page 7 of our report should be corrected—and the credit of the discovery should be assigned to Professor Wurtz. Dr. Torrey also was desirous that the change should be made.

MR. VOSE'S REPORT.

Mr. Vose made geological examinations in connection with trigonometrical work in the southern part of the White Mountains. He has forwarded a manuscript sketch of his results, with specimens, and a catalogue. They are too voluminous to be presented at this time. Later in the season he made a trip to Mount Carrigain, one of the most interesting and least known of the White Mountain summits. It lies west of the Saco valley, and the notch north of it, as already mentioned, is grander and deeper than that of the Crawford House. If only for the summer travel, there should be a road constructed through this notch, especially as the route between Franconia and North Conway would thus be shortened, and an immense tract of land now unoccupied and scarcely owned by anybody would be thrown open to the public. As this mountain is destined to be better known hereafter, I enclose extracts describing it from Mr. Vose's letter:

"Mount Carrigain stands almost exactly in the center of the vast group of the White and Franconia mountains; and rising, as it does, to a height of nearly five thousand feet, is a marked feature in the landscape from almost every point of view. Conversely, the view from Carrigain must embrace the whole mountain mass, and must sweep around over all of the principal summits.

"The readiest point from which to reach it is at Stilling's Hotel on the Saco river, fourteen miles above North Conway and a dozen below the White Mountain Notch. The path leads up Sawyer's river, a tributary of the Saco, rising partly upon the mountain itself. * * * * *

"Although Mt. Carrigain is a most prominent summit when seen from a distance, it is not at all so from its immediate neighborhood; since lower mountains lie in front of it, and hide nearly all of it; and a short distance above Upper Bartlett, it disappears altogether from the traveler upon the highway.

"The morning was bright and clear, and promised good weather for the ascent. Leaving our hotel directly after breakfast, we drove to Lawrence's farm, and sending back our team, strapped our packs upon our backs, bid good bye to civilization and our paper collars, and took to the woods, following up the north bank of Sawyer's river. A walk of a little more than an hour brought us to Duck Pond stream, a tributary of the river from the north. Crossing this brook, we continued in a northwesterly direction for an hour and a half, when we struck Carrigain brook, the second tributary from the north of Sawyer's river. This brook has its rise both upon Mt. Carrigain and in the deep notch east of it, and thus leads by its west fork directly to the top of the mountain. Proceeding up the brook for an hour, we stop ped at the foot of the ascent, which was now directly in front of us, to dine; and after a short rest commenced the climb, following the bed of the stream, which tumbles down the steep eastern slope of the mountain.

"The summit of Carrigain is 4800 feet above the sea; the base of the mountain is probably about 1200 feet in height, thus leaving 3600 feet from the summit to the level of Carrigain brook, at least 3000 of which is in one almost unbroken slope, so steep as to require the constant use of both arms and legs in its ascent. The west fork of the brook leaps down for a great height over broad steps of granite, and this gigantic flight of stairs affords for a considerable distance the best means of ascent. The bed of this brook we named for our guide, who was the first to ascend, Cobb's Stairs. We kept the stream for about 1000 feet of vertical ascent, at which point it became so abrupt, that we were forced to abandon it for the wooded slopes, where the foothold was better, and the trees offered us the assistance we needed for dragging up the constantly increasing weight of our bodies. The surface of the magnificent slope up which we were now toiling appears to consist entirely of loose angular blocks of granite dislodged by the frost, and covered with a deep matting of rich green moss, in which we sink to the ankles, and through which we not unfrequently break into some crevice up to the middle. For about two hours we work doggedly up this apparently interminable slope, keeping the brook always in hearing, in order not to get beyond our supply of water for the night, stumbling now into some hidden chamber beneath the moss, now lifting ourselves up by the friendly branches of spruce and pine, now sinking exhausted into the soft green bed beneath our feet, now winding around some fallen tree, still up, up, up we go, panting and straining with every muscle called into play, and every drop of blood in vigorous motion, till the distant mountains begin to lift their blue heads above the decreasing trees, till exhausted nature calls loudly for rest, and the small rill trickling beneath our feet is all that remains of our brook.

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"Daylight found us ready for the final pull, which should place us on the summit of Carrigain. Dispatching our breakfast, and taking nothing but note-book and compass, we move slowly up, threading our way sometimes on foot, sometimes on our hands and knees, among the scrub spruces, and sometimes upon the rough gray blocks of granite that strew the mountain side, till a shout from the guide sends new vigor into our muscles, and one more lusty pull and a rough scramble through the bushes and over the rocks, and we stand upon a narrow ridge, from which the great slopes sweep down in one unbroken descent to the green carpet of forest, spread out like a map beneath.

"While we had been engaged in reaching this point, the clouds had not been idle; indeed they were a little ahead of us, and when we arrived upon the summit we found the mountain mists creeping slowly in upon us, and one by one wiping out the great ranges that surrounded us. This was not pleasant; but we had come too far to give up the view from Mt. Carrigain, and making a good fire we sat down and awaited better times. Fortunately they were not long coming; and when we least expected it, a rift in the vapors showed the wide ring of the distant horizon, and the surging swell of the vast landscape around us.

"Directly opposite to Mt. Carrigain, upon the east, rises a noble summit, scarred with tremendous slides, and forming with Carrigain a notch not inferior in depth or abruptness to the White Mountain Notch itself. This fine summit we named Mount Lowell, in honor of one of the oldest and most enthusiastic among White Mountain explorers, Abner Lowell, Esq., of Portland. The slopes of these two mountains in Carrigain Notch are more imposing, both on account of their exceeding steepness and of their great height, than any others yet described in the White Mountains. The distant view too in every direction is full of interest; ranges and notches, huge mountains and broad valleys, never seen from the points commonly visited in this region, are spread all around. From its central position a better idea of the arrangement of the White and Franconia Mountains is had, than from any other point, perhaps, in the whole group. To the east we see Washington, Monroe, Franklin, Pleasant, Clinton, Jackson, Webster, Resolution, Giant's Stairs, Crawford, the Carter Mountains, Doublehead, Kiarsarge, and the lower summits of Jackson, Chatham and Bartlett; to the southeast and south, the Mote, Chocorua, Tremont, Table Mt., Passaconnaway, Whiteface, Squam and Tripyramid; while to the west and northwest lie the Franconia and Twin Mountains, and the great mass of ridges and valleys between the Saco and the Pemigewasset. The view from Carrigain opens new fields in every direction for mountain exploration; and it is to be hoped that the many persons frequenting the mountains, and fond of rough tramps, will ere long penetrate these interior recesses of the wilderness, and acquaint us with the topography and geology of this now unknown part of the White Mountain group.

"Probably the best mode of ascending Carrigain will be to go up over the long ridge to the south, and not up the steep slope above described; in which case the ascent will be easily made between breakfast and supper, and the descent the following day.

"Having completed our observations we returned to camp, dined, packed up, descended the mountain, camped for the night in the valley of Carrigain brook, and the following morning returned to our hotel in Bartlett, arriving in time for dinner, having accomplished the long cherished desire of looking into the great central wilderness of the New Hampshire Mountains, and of becoming better acquainted with the form and arrangement of the various summits and ranges to the east and south.

"To all true lovers of mountains and of nature in her wildest moods, to those who relish a tramp through the woods and a bed upon the ground, to all who wish to 'drink the wine of mountain air,' and to store their memory with splendid pictures that never fade, we say—try Mount Carrigain!"

LEAD MINES.

A brief notice was given last year of the Carroll county silver lead mine in Madison. On our return from Conway in October last, we hastily glanced into the mine, and took away specimens for analysis. The rock is a quartzite, near an immense sandy plain, where rock exposures are almost unknown. An egg-shaped excavation has been made into this rock, not less than forty feet wide and perhaps sixty feet long by seventy-five deep. The wall rocks have a high westerly dip, and the vein is six feet wide. The ores are galenite and blende, of which only the former is utilized at present. There is a force of twenty-five men employed to mine, raise, sort and crush the lead, which is sent to New York to be smelted and to be resolved into lead and silver. Professor Seely's assay of the galenite shows that it contains of silver to the ton of 2000 lbs., ninety-four ounces, eleven pennyweights and five grains, or nearly eight pounds.

This mine was first known in 1826. It has been occasionally worked, but never so energetically as at present. There is machinery on the ground worth $50,000, including one steam engine of eighty horse-power, a second of fifteen, a twenty-four stamp mill and Cornish crushing rolls, capable of pulverizing a ton of rock in ten minutes. During the past winter the amount of ore dressed to seventy per cent. of lead has averaged one barrel per day. In the spring and at present this rate of production has been doubled. The actual selling price is $113 per ton, or $55 for the silver and $58 for the lead.

About two miles northwesterly is another lead mine chiefly owned by H. J. Banks of West Ossipee. The vein is about five feet wide with a siliceous gangue, is in a hard sienitic rock, has been opened in four or five places, and has been traced along its course for half a mile. The principal opening is 45 feet deep with a shaft house. There is a little zinc with the lead. Assays have shown that the galenite possesses the same proportion of silver as that from the adjacent mines.

The lead and zinc ores at the Warren mine have been taken out during the past year in considerable amount, but I am not able to give the number of tons.

Early in October I examined a lead mine in Rumney in company with George L. Merrill, Esq., of Rumney. It is in the northeast corner of the town. The rock of the country is porphyritic granite. The metalliferous mass is twelve feet wide, exposed in an excavation fourteen feet deep. The walls dip eighty degrees north, sixty degrees west. They are composed of a soft feldspathic rock, with quartz rock within. The center is composed of two kinds of trappean rock, of which the lighter-colored variety had been erroneously called limestone. The ores are galenite and blende, which seem to follow reticulating veins of quartz. The excavation is hardly sufficiently extensive to enable us to form a satisfactory opinion of the value of the mine. There is another interesting lead vein on the Pinnacle in Hooksett.

VARIOUS EXCURSIONS.

During the year special excursions have been made in several parts of the state, and for definite objects. There is time only to mention their titles. Several days were spent in August in examining the flinty slates and granitic beds about Portsmouth, York, and the sea-coast towards Seabrook.

A trip was made to the Francestown soapstone quarry, and its extension into Weare examined upon the land of Hon. M. A. Hodgdon. I understand that since that time extensive excavations have been made upon the latter, with interesting results.

The country west of the gneissic region along the Connecticut, from Hinsdale to the Canadian border, has been traversed partly by Mr. Huntington and partly by myself. In its scientific relations much remains to be learned, and in general and scientific importance it will probably not be surpassed by any section in the whole state.

Trips for special purposes were made to Conway and Gorham. Our objects in the former case were not accomplished on account of the terrible freshet of October. After vainly striving for several days to carry out our plans of exploration in Conway and vicinity, the project was abandoned, and our operations were transferred to Lyman, where the snow finally put an end to all geological activity for the season.

SULPHUR.

Within a few years a new impulse has been given to mining for pyrites on account of the sulphur contained in it, for the manufacture of sulphuric acid. This is used in bleaching, fabrication of artificial fertilizers and a hundred other ways. Quite recently chemical works for the utilization of the sulphur have been established about the principal cities, and there is a great call for the ores containing the sulphur. By the burning of the ore — a sulphuret of iron — the sulphur takes oxygen from the air, becoming sulphurous acid. This is condensed in water in leaden chambers, where an additional atom of oxygen is added, and the resulting compound is sulphuric acid. One of the principle sources of this pyrites is Strafford, Vermont, where for forty years copperas has been manufactured. From that single locality on Copperas Hill it is estimated that four hundred thousand tons of ore will be shipped to market during the year 1870. As this passes over the railroad it is obvious that a new traffic is springing up, much to the advantage of the transportation companies, and consequently to the community.

It is with great satisfaction that within the year we have seen veins of pyrites in New Hampshire that can be successfully mined for the manufacturing establishments, and probably at remunerative prices. These veins are also nearer the market than those of Vermont, which are now mined so largely. Perhaps the most important of these is in the southwest part of Croydon. This has been visited twice; in June, 1869, and May, 1870. The results of our examination are briefly these: The rock is micaceous and gneissic, one of the subdivisions of the White Mountain series probably. It is elevated two or three hundred feet on the southeast flank of Croydon mountain. Higher up is the quartzite dipping at a high angle to north sixty-five degrees west. It probably overlies the sulphuret schist unconformably, as it certainly does three miles further north, the latter dipping eighty degrees west ten degrees south. One or two hundred feet east of the vein is a white gneissic rock, carrying an unusual amount of mica. This is parallel with it and may be used as a guide in tracing it through the country. In this way the vein was followed three-fourths of a mile to the north, and from what was said to us, it is judged to extend equally far to the south. The vein has been opened to the depth of twenty-five feet. It was full of water at our first visit, but was drained at the second visit by means of a syphon. The vein mass is uniform in its width and composition. Next the hanging wall are six inches width of slaty layers holding both copper and iron pyrites. Next succeeds two feet thickness of magnetic pyrites or pyrrhotite, very compact, solid, and nearly pure. There is no foreign mineral present except small nodules of quartz. Next follows one foot ten inches of the same, less compact. Fourthly are two feet thickness of gangue of quartz or a micaceous mass carrying a large porportion of copper pyrites and zincblende. Below all this is a slaty mass three or four feet in thickness, similar to the upper layer, carrying considerable pyrites, which may possibly be utilized. The second, third and fourth of these layers are valuable, and united amount to six feet in thickness. By Prof. Seely's determination the sulphur in No. 2 amounts to 37.68 per cent.; in No. 3, to 38.10 per cent.; and in No. 4, to 19.35 per cent. No. 4 also contains 3.17 of copper and 16.62 per cent. of zinc.

On examining the veins to the south the sulphurets are found cropping out on the surface for one or two hundred feet, and the vein itself can be traced on the property nearly to a house eighty rods distant. Further tracing was not attempted in this direction. It is common for this vein to be cut by irregular veins of white quartz.

The outcrops are on a steep hill, perhaps three hundred feet above a comparatively level tract. Thus the vein could be easily drained, whether an adit be driven in from the bottom of the hill at right angles to the vein, or from the north and driven in on the vein itself. This site is less than three miles in a gently ascending country from a contemplated station on the western division of the Concord and Claremont Railroad, now under contract. Thus this vein is one that carries an abundance of ores, and it is very conveniently situated with respect to transportation to the market. Compared with the Strafford ores, it may be said there is six miles less distance by carriage over common roads and forty miles less distance by railroad to Boston. Judging from the present rates of freight, cost of mining and value of the ores, it is probable that the pyrites can be delivered at chemical works about Boston, at a profit of four or five dollars per ton. With such profits there is no danger that this property will long remain unworked, and the beginning of the mining of sulphurets will open a new source of prosperity for Sullivan county.

Next in value is the Neal mine in Unity. This has been visited three times. It is owned by H. and O. Neal, and is about four miles from North Charlestown, on the Sullivan Railroad. The vein has been described in Dr. Jackson's report. It is a mixture of iron and copper pyrites, nearly three feet wide, and has been traced fully 2,200 feet in length. Drainage can be effected to the depth of 70 feet. The vein dips 78 deg. west 10 deg. north. It has the same geological position with the Croydon mine, lying near the western border of the gneiss, and if the ores were mixed it would be difficult to distinguish many of the varieties from each other. It is probable that the ore would all become copper pyrites at 100 feet or more below the surface.

There are other interesting veins on this property, but it is only sufficient for our present purpose to say that the pyrites can be as profitably mined for sulphur here as at Croydon, and if copper or other valuable metals should be ultimately discovered in abundance, it might be wrought for these metals, and thus its value be increased. It is to be hoped that means will soon be found for developing this property.

Other veins carrying considerable amounts of pyrites, which are all worthy of exploitation with the hope of successful results, are the King property upon C. Houston's land, in the southeast part of Hanover; the land of J. W. Cleaveland, of East Lebanon, in the northwest part of Enfield; a location, name unknown, in the southwest part of Lebanon; Dr. Hubbard's mine on the Jackson farm, in the south part of Claremont. On account of the great value of this ore in the manufacture of fertilizers, it is to be hoped that these veins will be thoroughly explored, the market well supplied with sulphuric acid, and thus both the mining district be benefited and the prices of the phosphates be reduced, and the whole community reap the advantages of lower prices of fertilizers.

MAP OF KEENE.

Mr. G. A. Wheelock, of Keene, has been very much interested in tracing out the outlines of the rock formations in the town of Keene. He has, at his own expense, explored the whole of the township, colored a large map, and written out a descriptive sketch, published in the *Sentinel.*

This he has kindly sent us, and he has continued his explorations during the present year. In this sketch he describes vividly the great forces which have upheaved the mountains, broken and separated far apart the same rock by means of erupted granites, and also the glacial forces which in later times have excavated valleys, worn out potholes, and transported boulders from Mount Ascutney thirty-seven miles in a right line.

GEOLOGICAL MAP.

That you may be kept informed of the general progress of our work, I have prepared a geological map of the state, showing, so far as has been discovered, the outlines of several of the formations. The map has been engraved anew from data in our possession, and it is the most accurate in respect to town boundaries, the courses of rivers, the outlines of lakes, the site of railroads, etc., that has ever appeared. We had not the means to represent adequately the mountains. The triangulation thus far accomplished is also shown upon it.

The distinctions presented are the following:

1. White Mountain, or gneissic series.
2. The sienite group of Exeter and Dover.
3. Porphyritic granite.
4. Common granite, especially that quarried for building purposes.
5. The Merrimack schists and slates.
6. Quebec group.
7. The Coös group of slates, schists, quartzites, etc.
8. Calciferous mica schist.
9. Clay slates.

Others might have been added, but these are sufficient for our present purpose. I will say a few words about each group.

1. *White Mountain or Gneissic Series.* In our Report of

last year, this term was used to indicate the general mass of gneissic and granitic rocks of the state, including designations three and four of the present map. It occupies four fifths of the area of the state, and it will be a leading object of our survey to discover the relations of the several members of the group to one another. It may not be amiss to state that the clue to the structure of the whole has probably been discovered, and that by diligence and discrimination it can be completely followed out. The practical advantages of this knowledge can hardly be overrated, since information will at once be afforded restricting the occurrence of valuable minerals to narrow areas, where the proper research will develop them. I refer to such minerals as the soapstone of Francestown, the pyrites of Sullivan County, the mica of Grafton, granites, limestone, feldspar, tin, lead, etc.

I am satisfied that the following are some of the subdivisions of this group, which further explorations will enable us to define with precision: 1, normal gneiss; 2, ferruginous gneiss; 3, granitic gneiss; 4, feldspathic mica schist; 5, andalusite gneiss; 6, chiastolite slates; 7, granite; 8, sienite; 9, porphyritic granite; 10, quartzites; 11, limestones; 12, soapstones. Little doubt remains as to the Eozoic or pre-Silurian age of this entire series.

2. *Sienite of Exeter and Dover.* There appear to be sienitic rocks of probable Laurentian age, equivalent to the Quincy sienitic group of Massachusetts, prominently exposed along the Boston and Maine Railroad, between Massachusetts and Maine, especially in the towns of Exeter and Dover. They form, apparently, an anticlinal mass, overlaid by the Merrimack slates.

3. *Porphyritic Granite.* Common granite full of large crystals of feldspar, generally from one-half to two inches long, which give a checked appearance to the ledges. Some portions of it have evidently been injected, while the ar-

rangement of the feldspathic crystals in parallel lines leads to the suspicion of stratification in other cases. When accurately mapped its area will resemble the trunk and branches of a decayed tree—the branches corresponding to the veins which have been ejected from the original mass.

4. *Common Granite.* It was our intention to have presented an elaborate sketch of the history of the production of granite in New Hampshire, its principal localities with reference to convenience of access by railroads and steamboats, statistics of its production, and a scientific inquiry into the reasons of the superiority of granite over other building and monumental stones. Time and the required brevity of our report have prevented the accomplishment of this purpose. But the map will show how far the localities are reached by freighting facilities. *First*, granite may be expected in any town situated within the White mountain series of rocks. It often occurs in comparatively small lots, so small as scarcely to make a figure upon the map, while it possesses a superior quality. The granites of Concord and Fitzwilliam are thus comparatively limited, while the coarser porphyritic group is extended over a large area. *Second.* The famed quarries of Concord, Fitzwilliam, Hooksett, Marlboro' and Troy are directly upon railroads—those of Sunapee, New London, East Lisbon, and other places are not so convenient for transportation, while unwrought mountains of granite abound both near to and remote from railroads, as in Brookfield and New Durham, Wentworth, Ossipee and Green mountains, the Conway district, the Mt. Washington area, the unfrequented townships of granite west of the Saco river in Grafton county, the peaks in Stratford, Columbia, Millsfield, and others. The attempt is not made to represent the granite entire—only such large masses as have fallen under our direct observation. Still enough is represented to show the appropriateness of the name of "Granite State" to New Hampshire.

The granite of New Hampshire seems to have originated at five different periods. First are the (*a*) indigenous and (*b*) eruptive granites of the White Mountain series; second, the (*c*) indigenous granites of the Merrimack group, in which none of the eruptive class have yet been seen; third, the (*d*) indigenous and (*e*) eruptive granites of the Coös and calciferous mica schist groups.

5. *Merrimack Group.* This name was informally applied by my father to the mica schists, slates and quartzites contained in the valley of the Merrimack river in Massachusetts. They skirt the Exeter sienites in New Hampshire, lying in troughs, on the flanks of an anticlinal. They probably belong to the earliest Silurian series.

6. *Quebec Group.* Lower Silurian, according to Sir William E. Logan, and largely developed in northern Coös county, the Ammonoosuc Gold Field, and along the Connecticut river, chiefly in Vermont, to Bellows Falls.

7. *Coös Group.* Under this appellation, for want of a better name, are included the argillaceous schists, whetstone mica schists, grits etc., of northern Coös county, as explored by Mr. Huntington, the similar and associated rocks in Barford, Hereford, Auckland, etc., P. Q., and Essex county, Vt., the quartzites, staurolite rocks, micaceous schists, hornblende schists, perhaps gneiss, protogine and other rocks west of the White Mountain series and east of the Connecticut river, along the whole of western New Hampshire, but excluding the calciferous mica schist (8). The unity of the series, its age, thickness, and relations to the Quebec group and (8) remain to be defined. It appears clearly to overlie the White Mountain veins unconformably.

8 and 9 seem to be limited outliers in New Hampshire.

ASSISTANTS.

In our work the past year assistance has been furnished by J. H. Huntington of Hanover, G. L. Vose of Paris, Me., Prof. E. T. Quimby of Hanover, Prof. E. P. Barrows of Middletown, Conn., T. M. Blossom of New York city, A. C. Page of Centre Harbor, E. R. H. Hodgman of Mason, A. A. Woolson of Lisbon, Prof. C. A. Seely of New York, besides others who have temporarily aided us, and there have been laborers employed by the day. Their services were mostly gratuitous. The first named gentleman has devoted his entire time to the work, and he has labored with incessant perseverance and marked success. We regret that his carefully prepared report cannot be presented in full. No more accurate work has been performed than that of Mr. Vose, among the White Mountains, and it was a great source of sorrow to us that unforeseen circumstances prevented him from spending much time in the field. Professor Quimby's work proves itself, and therefore carries internal evidence of its thoroughness. Professor Barrows and Mr. Blossom performed eminent service in measuring sections, especially when I was unexpectedly called away to other parts of the state. Mr. Hodgman spent a short time with Mr. Huntington in Coös county, but his engagements prevented him from spending any time with us the present season as we had earnestly desired. Messrs. Page and Woolson aided in setting the stakes in Lyman, and it is a pleasure to be reminded of their zeal and fidelity. Professor Seely has attended to the assays, and has made some twenty-five or thirty determinations, some of which are reported elsewhere. It would be difficult to say where more efficient aid could have been found, than was afforded by these gentlemen, and our only regret is that we had not the means to employ them constantly.

By an oversight we neglected to mention in our last report the eminent assistance given us in Coös county in the fall of 1868 by Professor S. C. Chandler of East Middlebury, Vt.

ACKNOWLEDGMENTS.

Our acknowledgments to various gentlemen for acts tending to aid the work of the survey have been so numerous that but few can be alluded to. I may mention in particular S. N. Bell of Manchester, H. H. Harriman of Warner, Hon. M. A. Hodgdon of Weare, John J. Bell of Exeter, Professor C. A. Young of Hanover, Dr. E. E. Phelps of Windsor, Vt., G. E. Jenks of Concord, Chase and Howe of the Winslow House, Wilmot, Samuel Orr of Goffstown, Daniel Pecker of Raymond, William Little and John A. Riddle of Manchester, George A. Wheelock of Keene, J. H. Pope, M. P., of Cookshire, P. Q., F. C. Jacobs of Connecticut Lake, C. P. Richardson of Mason village, and others.

The Trustees of Dartmouth College have kindly continued to furnish without expense the rooms required for storage and care of the specimens, and the Superintendents of the C. & P. R. R., Vt. C. R. R., Vt. V. R. R., Vt. & Mass. R. R., Cheshire R. R., B. C. & M. R. R., N. R. R., Concord R. R., and the manager of the B. L. & N. R. R., have remembered us this year as before. The American Geographical and Statistical Society of New York have furnished us with copies of all the county maps, and have distributed without expense to us a large number of our reports to scientific societies in Europe.

MUSEUMS.

You do not need to be informed of the munificence of the Trustees of Dartmouth College and of the Legislature in providing funds for the erection of a building at Hanover, for the purpose among other objects, of exhibiting the specimens collected by the Geological Survey, which are to be given to the New Hampshire College of Agriculture and the Mechanic Arts. The progress made in the erection of this edifice has been communicated in the Report of the President of the Agricultural College, and it is expected that before the close of another year, the specimens illustrating the sections and the natural resources of the state, will be placed there on exhibition. A room on the second floor about 45 feet square has been set apart for this purpose.

But as only half the specimens are to be displayed at Hanover, I desire to call your attention to those that are intended for the State-House. Over a thousand are now ready, and there will be sufficient to fill a room as large as the one at Hanover devoted to this purpose. In fact the assurance that no place has yet been provided for the reception of specimens at Concord has prevented their accumulation as rapidly as might have otherwise been the case. I sincerely trust that this subject will meet early attention from you before those who have in charge the assignment of the rooms in the State-House to their proper office.

Hoping that the interest universally expressed in the progress of our scientific investigations may be combined with wisdom in the choice of method employed in exploration, and that the results produced may be worthy of the old Granite State,

I am,
Respectfully yours,
C. H. HITCHCOCK,
State Geologist.

Hanover, N. H., June 6, 1870.

REPORT

OF THE

GEOLOGICAL SURVEY

OF THE

STATE OF NEW HAMPSHIRE,

SHOWING ITS PROGRESS

DURING THE YEAR 1870.

BY
C. H. HITCHCOCK, PH. D.
STATE GEOLOGIST AND HALL PROFESSOR OF GEOLOGY AND MINERALOGY
IN DARTMOUTH COLLEGE.

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REPORT.

Hon. N. W. Gove, Secretary of State:

Respected Sir,—I have the honor to present you herewith the Report of the operations of the Geological Survey, during the year ending June 1, 1871. Only a rough abstract of its doings can now be presented, although an immense amount of detail has accumulated for description.

THE WHITE MOUNTAINS.

The most laborious field of research, the past year, has been the White Mountains, particularly the region about thirty miles long and twelve or fifteen wide, bounded by Israel's, Moose, Peabody, Ellis and Saco rivers. This area is nearly an unbroken forest, traversed only by the bridle paths and roads required for the ascent of Mount Washington by summer visitors. The plan pursued was to visit systematically every one of the numerous peaks and valleys composing this area, with the hammer and barometer. As the result of our labors, a physical model of the mountainous region has been constructed, about five feet in length, on the scale of one hundred and forty rods to the inch horizontally, and one thousand feet to three-fourths of an inch vertically. Contour lines were drawn for each five hundred feet, and were made the basis for fashioning the mountains. With our limited resources, much reliance was placed upon estimates of the location of the contour lines, without actual measurement. Hence this model is only an approximation to a correct representation, but is sufficiently accurate to enable all interested in the study of the mountains to comprehend the relative altitudes and courses of the ranges, especially as they stand related to the distribution of the formations.

After the exhibition of this model in public, information was furnished that the greater part of the White Mountains had been fashioned in plaster, several years since, by Rev. Dr. Thomas Hill, lately President of Harvard College. This model was upon a much smaller scale, about eighteen inches square, and was built up upon the basis of Bond's map of the White Mountains, published in 1853. It includes the Franconia region, and all the mountains as far south as Waterville and Conway. An inspection of this representation shows great familiarity with the structure of the mountains, and it is a matter of regret that its existence has been known to so few persons. A copy of it has been presented to us by the author, and is placed in the State Museum at Hanover.

So numerous were the localities requiring visitation that six of the members of the class of 1871, of Dartmouth College, C. S. D., were invited to assist in the work of exploration. These were B. W. Andrews, W. B. Douglass, C. J. Johnson, J. F. Pratt, E. Thompson and Frank Woodbridge. Aid was also furnished by J. H. Huntington, Dr. Nathan Barrows and E. Hitchcock, jr. We procured the necessary provisions and other supplies, and lived among the mountains, in extempore camps, till the various points had been explored and the required observations made. Without so many assistants the early completion of this work would have been impossible, and all who take pleasure in contemplating the results are under obligations to these gentlemen for their very arduous labors.

That it is very difficult to climb high mountains is a statement which no one will deny. Most persons who visit our New Hampshire mountains are well satisfied with their labors when a single peak has been ascended on foot. They are willing to accept almost any theory that may be proposed to explain their geological structure, because immense labor would be required to disprove it. The task before us was the dissipation of all false notions, and the discovery of the real stratigraphical structure of the interior of the rocky masses, by careful induction. The whole party were animated with the desire to accomplish this object, and therefore visited the almost inaccessible peaks and ravines, one after another, till all had been explored. The actual exertion often put forth for procuring a single specimen was greater than to pass over Mount Washington on foot, by the paths. Its location may have been three or four thousand feet above the camp, and the country to be travelled was the original forest, never before traversed except by hunters, full of underbrush, fallen trees, and at the higher elevations consisting of the stiff dwarf spruces, through which travelling is almost impossible. After overcoming the difficulties of threading the forest and ascending the precipices, the rarified air of the upper regions has made even slight exertions burdensome. We take great pleasure, therefore, in pointing to the results of our labors, as they have been acquired only through infinite toil; and we feel sure that if our generalizations are not accepted, it will be a long time before any other party will labor so hard as we have done to disprove our theories.

It will be possible to present only a brief statement of our conclusions at this time, by the limitations of the legislative act. Hereafter the whole may be expected. As a preliminary we present a historical review of the opinions that have been expressed in our scientific literature, concerning the structure and age of the White Mountains.

HISTORY OF OPINIONS.

Very many speculations have been entertained respecting the rocks, elevation and age of Mount Washington and the associated mountains. The older geologists supposed there had been an igneous ejection of granite which burst through originally horizontal strata, heaving them up while the lava poured over them. Prof. O. P. Hubbard,* while indorsing this theory, pointed out some errors of previous observers. "The foundation of the mountain, as shown by slides upon the west side," he says, "is granite. The top has been stated by those who have and by others who have *not* ascended it to be granite;" but he found it to be mica slate. "The case is clear. The mountain of granite was raised from the deep, bearing upon its Atlantean shoulders the huge covering of mica slate, that extends a quarter of a mile below the summit. The granite, instead of upturning the mica slate, and protruding at the center of elevation, itself forming the peak, has broken it at some distance from the center."

Dr. Charles T. Jackson, when engaged upon the geological survey of the state in 1840, was one of the party who first ascended Mount Washington on horseback, Abel Crawford leading. He says, "the geological features of Mount Washington possess but little interest, the rocks in places consisting of a coarse variety of mica slate, passing into gneiss, which contains a few crystals of black tourmaline and quartz.* The geologist will remark that the mountains are not grouped at random, but form regular ranges, running in definite directions coinciding with the axis of elevation.† In 1842, Assistants Edward Hale and W. F. Channing found "an abundance of fibrolite or fibrous kyanite on Mount Jefferson." Dr. Jackson says, "the results of the exploration were important, since the observations made in the bed of Israel's River proved the nucleus of the White Mountain range to be granite rock, and the mica slate seen on the summit of the mountain is but a superficial crust or superimposed layer."‡ In the section given from Maine across New Hampshire to Vermont, the mountains are represented as entirely composed of granite, flanked by gneiss and mica slate.

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* Amer. Jour. Sci., I, Vol. 31, 1837.

E. Hitchcock, in 1842, describes the ridge between Mounts Clinton and Washington as made of feldspathic mica slate with veins of granite, and abounding in a mineral resembling fibrolite.§

In 1846, Professors H. D. and W. B. Rogers described the rocks in the Notch.‖ These were a group of highly metamorphic sandstones and slates, traversed by enormous beds and veins of syenitic granite. Near the Willey House there is described an anticlinal line with the course northwest and southeast. Some of the rocks contained fossils, allied to those of the Levant series or base of the upper Silurian, these strata resting upon Matinal and Primal strata. Hence the central mass of the mountains was regarded as older than the fossiliferous slates, and, of necessity, the structure anticlinal. They found two interfering sets of dips and archings, thus proving two periods of flexure, and from different directions. This repeated lateral pressure was regarded as the cause of the great elevation of the White Mountains, just as the level of waves is highest at the intersection of two crossing billows. The epoch of the first elevation was between the Matinal and Levant; the second, at the close of the Carboniferous. Subsequently these gentlemen stated that they no longer regarded these "fossils" as genuine.¶

In 1854, T. Sterry Hunt presented arguments from the lithological character of the limestones of Eastern New England, to show that this gneissic area should be regarded as Devonian.* This view indorses a similar view of Sir W. C. Logan, based upon structure and expressed in 1848.† The opinion of Devonian age seemed to involve a synclinal structure in the range itself.

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*First Report, 1841, p. 102. †Id., p. 103. ‡Final Report, p. 160.

§Trans. Amer. Asso. Geologists and Naturalists, p. 184.

‖Amer. Jour. Sci., II, Vol. I, p. 411.

¶Id., Vol. V, p. 116.

J. P. Lesley's visits, in 1849 and subsequent years, led to the foundation for a growing conviction that the White Mountains range would prove to be synclinal in form. A section made along the Grand Trunk Railroad, across the state to the north, in 1857,‡ showed him a synclinal structure, with comparatively low dips, and at least two main anticlinal divisions. He recognized the synclinal form also among the granites of Waterville, a considerable distance south. These granites show plates as evidently and regularly bedded as any of the sandstone masses of the Alleghanies, dipping from ten to fifteen degrees. Between the granites are altered dark blue sandstones. All these metamorphic rocks he conceives may have originated in the clayey sandstones of Formations VIII., IX. and X. of the Appalachians.

In 1858, the author drew a section from Tuckerman's Ravine across the mountain to Lake Champlain. The section is apparently synclinal, but the figures of dips, given in the text, showed it to be irregularly monoclinal, the dips being 28° westerly, 25° northwesterly and 30° northerly.§ It is here erroneously stated that the rocks between the Lake of the Clouds and the Crawford House are entirely of granite.

In 1867, G. L. Vose takes the ground that the main range is neither an anticlinal nor a synclinal, but the fragment of a great anticlinal, the line passing along the valley of Peabody river, while the counterpart of the westerly dip is to be found in the range of Carter Mountains in Bean's Purchase.‖

In 1870, Dr. Sterry Hunt advances new opinions. The minerals andalusite, cyanite, etc., seem to him to have been formed in a very ancient period, and therefore a very large part of the Eastern New England region is older than Silurian. He styles the new group *Terranovan*.¶ In our recent report similar views are presented, and the distribution of the andalusite rocks in New

* Id. Vol. XVIII, p. 199. † Geol. Rept. Canada, 1848, p. 58.

‡ Proc. Acad. Nat. Sci., Phila., 1860, p. 363.

§ Final Rep. Geology of Vt., Vol. II, p. 653, plate XVII.

‖ Proc. Amer. Asso. Adv. Sci., 1867.

¶ Amer. Jour. Sci. II, Vol. 4, 1870.

Hampshire is marked on the map under the appellation of *Coos Group*; but this new system does not embrace the lower rocks of the White Mountains, as they appear to underlie the upper andalusite series uncomformably. A sketch of the geology of the White Mountains was presented by the author, at the Troy meeting of the American Association for the Advancement of Science (1870), in which the views expressed in this Report were brought forth.

STRATIGRAPHICAL STRUCTURE OF THE RANGE.

The structure of the Mount Washington range seems to be that of an inverted anticlinal. On the east side the andalusite slates of the Coos group are developed in great force. At several places these dip to the east. A common phenomenon is the occurrence of a low, undulating, easterly dip, extending for several rods; then the strata suddenly change and dip nearly vertically, sometimes folding underneath the first mentioned ledges. In the deep valleys of Tuckerman's Ravine and the west branch of the Peabody river, the dip is universally westerly. On the west side, about three-fourths of a mile above Marshfield, loose fragments of staurolite slate are common. It is probable this rock is in place, though its ledge has not yet been discovered. The strata forming the crest of the mountain show a westerly or northwesterly dip, generally. From these facts the presence of an inverted anticlinal axis is inferred. An examination of the rocks of Bean's Purchase shows the westerly dip to be the prevalent one, and the rock is the common imperfect gneiss of the White Mountain range. Hence the theory of Mr. Vose cannot be maintained.

The overturn dips of the Appalachian region are generally regarded as produced by a lateral force pushing northwesterly from the ocean, thus explaining the prevalence of the southeasterly dip.

If this is a correct dynamical view, then the overturning of the White Mountains proceeded from a force acting diametrically opposite to the usual course, viz.: pushing southeasterly. If this be a fact, and the premise is reliable, then have we evidence of a state of things never before suspected. There must have been a long period in the early history of the earth, when the thinner portion of the crust lay to the northwest, and possibly an ocean spread over a large area on that side. The physical conditions were so different, that it is rational to believe that geological agencies were at work in a period never recognized elsewhere.

As the prevailing dip among the Coos rocks is westerly, we may believe that this new series of rocks represents a part of this singular period. From a comparison of dips this force seems to have been exerted towards S. 80° E.

Furthermore, in subsequent times there has been another force acting upon these strata, from an opposite quarter, viz.: S. 10° E. The result of this has been a reduplication of the original folds and numerous faults. Each flank of an anticlinal has been itself folded. Something of this kind seems to have been foreshadowed by the Professors Rogers, in the Notch. The best location to examine these counter courses is on the carriage road towards the Glen House from the summit, and along the main mountain ridge both north and south. There is no regularity either in the dip or strike of the strata. Their position has been shifted a dozen times in each half mile, and the strikes are as commonly at right angles to each other as parallel or transverse.

AGE OF THE WHITE MOUNTAIN SERIES.

In fine, the White Mountain rocks are believed to belong to two great systems, the Gneissic and the Coos Group. The first are, for convenience, called the White Mountain series, and in the area of the model are various imperfect gneisses, verging into mica schists, a few beds of genuine gneiss, granitic gneiss, andalusite gneiss and granite, both bedded and in veins. These rocks appear to underlie the Coos group, and are therefore older. The presumption is that they are entirely Eozoic, though it is not clear whether they are to be considered as the equivalent of the Laurentian of Canada, or more nearly the age of the Cambrian of Great Britain, as restricted by the Government Survey.

This White Mountain series has a great development in the middle and southern parts of the state, perhaps embracing everything not included in the Exeter, Merrimack and Coos groups. Its satisfactory reference to the Eozoic series will enable us to clear up the obscurities of New Hampshire geology, and make the study of our own strata as interesting as that of the well established fossiliferous groups in other parts of the country.

THE COOS GROUP.

The true relations of the White Mountain rocks cannot be understood without a brief description of the pile of strata called in our last Report the *Coos Group*.

The rocks grouped under this appellation border the Connecticut river from Massachusetts to Canada and Maine, bifurcating in Stark. Its eastern border is uniformly a quartzite as far north as Lancaster, and it seems to lie unconformably upon the gneissic and granitic rocks to the east. This member often constitutes mountains, as Perry's Mountain in Unity, Tug Mountain in Newport, Croydon Mountains from Newport to Lebanon, Moose Mountain in Hanover and Lyme, Cube and Piermont Mountains in Orford and Piermont, Mounts Orne and Pleasant in Lancaster, etc. The dip is quite uniformly westerly, and there is no evidence to show that it has been overturned.

Several sections have been roughly measured across this group. The following are some of them, beginning with the underlying rock:

First, the *Hanover Section*. Gneiss. 1. Quartzite, 800 feet; 2. Staurolite schists, 2,100 feet; 3. Clay slates (? Coos), 2,400; 4. Mica and coarse schists, 4,200 feet; 5. Gneiss; 6. Hornblende schist.

Lyme Section. Gneiss, dip north. 1. Quartzite and limestone, 2,200 feet, dipping northwest; 2. Granitic gneiss, 1,700 feet; 3. Mica schist, 1,500 feet; 4. Clay slates, garnetiferous, 4,500; 5. Green schists, 3,791; total, 13,690.

Orford Section. Gneiss, dipping 20–25° S., nearly at right angles with course of quartzite. 1. Quartzite, 1000 feet; 2. Limestone, 100; 3. Granite or gneiss; 4. Argillo-sandy schist, 2,700; 5. Clay slate, 2,700; 6. Green soft schist, 1,900, clay slates, 1,500; 7. Hornblende schist, 2,300; total, 12,200.

Lisbon Section. Gneiss. 1. Quartzite, not measured; 2. Limestone, 50–100 feet; 3. Hornblende, staurolite and gneissic, 2,528 feet; 4. Staurolite slates, 3,365; 5. Garnetiferous clay slates, 3,078; total, 9,071.

Along Hall's stream, adjoining Canada, the rock is argillaceous, friable, often with quartz pebbles, and again a soft whetstone schist. No staurolite has been observed here. The staurolite and garnet are more common north of Umbagog Lake.

The Coos formation on Mount Washington appears to be an outlier. The most marked extends from Mount Madison to the head of Dry or Mount Washington river. Andalusite and staurolite are very abundant in it, some of the crystals of the latter being eighteen or twenty inches long. It is much folded, and appears to be an inverted synclinal, inclosed by the older gneiss, which latter also contains andalusite. Both these groups are included in the Terranovan series by Dr. Hunt, but we prefer, for the present, to restrict the name Coos to the upper portion. Other patches of the same rock appear near Mount Willard, on Pequawket Mountain, near Conway, and elsewhere.

Mineralogically the schists of the Coos group are distinguished by the presence of cyanite, andalusite, staurolite and the related minerals, being silicates of alumina without alkalies. The physical conditions which necessitated the building up of sediment destitute of alkalies must have been as peculiar as the unusual direction of the elevating forces already alluded to. Hence it is believed that these two physical peculiarities of composition and elevation necessitate the intercolation of a new geological period in the old calendar. Judging from fossils in Nova Scotia, this group is not far from the St. Johns slates in age. As originally defined, Coos includes the argillaceous schists, whetstone, mica schists, etc., of northern Coos county, the similar and associated rocks in Barford, Hereford, Auckland, etc., P. Q., and Essex county, Vt., the quartzites, staurolite rocks, micaceous shists, hornblende schists, perhaps gneiss, protogene and other rocks west of the White Mountain series and east of the Connecticut river, along the whole of western New Hampshire, but excluding the calciferous mica schist.*

VALLEY OF THE WHITE MOUNTAIN NOTCH.

The valley of the Saco river, in the White Mountain Notch, has been excavated out of granite by atmospheric erosion. Mount Willey on the west and Mount Webster on the east are composed of flinty rocks, both less liable to decomposition than the granite. As they form an anticlinal, though with an average dip of from seventy-five to eighty degrees on both sides, the granite is wedge-shaped, and consequently the disintegration has left very steep walls. This is like notches in granite in other regions, as on

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*Second Annual Report, p. 34.

Willoughby Lake in Vermont, and the famous Yo Semite valleys of California. The formation of the Notch valley by simple denudation suggests a like origin for other valleys of similar shape elsewhere.

Along the edge of the schists and granite of Mount Webster and further east, there are enormous veins of granite, six, eight and ten rods wide, cutting into the schists for scores and hundreds of rods. This condition of things argues a large degree of plasticity in the granite when formed. A true eruptive granite, almost a diorite, occupies a considerable area on the flank of Mount Webster, below the Crawford House.

THE STATE MAP.

The need of a new reliable map of the state was set forth in our last report. A bill was introduced providing for the publication of such a map, but it did not meet the approval of the Legislature. Our efforts to accumulate information that will be of use in the preparation of this projected map have not been discontinued, in spite of discouragement. Some of the material accumulated is the following:

First, a new map of Connecticut River, from Massachusetts to Connecticut Lake. Part of this was surveyed in 1825, with the expectation that a canal would be built along the river, as high as McIndoe's Falls, in Bath. This very valuable map was presented to the survey by Dr. E. E. Phelps, of Windsor, Vt. It is superior to the county maps or the state map of Vermont, and is therefore the best one in existence. It represents things as they were in 1825, but there has been little change since that time except in the construction of new turnpikes and railroads.

Messrs. Walling and Gray were employed late in the season to prepare a map of the river between Bath and Connecticut Lake, from new surveys. This has been done carefully, and constitutes a very important addition to our materials for the final map. These same engineers also made careful odometer surveys of the Mount Washington carriage road and the Fabyan turnpike, which are in our possession.

Secondly, there are the results of special surveys at various times. There is the Massachusetts line, specially surveyed twice; the northern boundary, measured with great care by the United States Government; the line between Maine and New Hampshire as far south as Wakefield; and lastly the survey of the coast line by the General Government.

We have commenced the preparation of a raised map of the state, for the museum, upon the scale of one mile to the inch. The table to serve as its foundation is already in position, and we have drawn upon it nearly all the outside boundaries of the state, for most of which there have been special surveys. Mr. Huntington has colored a map to represent the contour lines of Coos county, and with similar maps of the White Mountains and of the southern counties in hand, we shall soon be prepared to complete the task assigned us. It is hoped that the preparation of this fixed model may lead the way to the printing of a state map, upon the scale of two and a half miles to the inch — such as would adorn any house within the commonwealth.

A TRIGONOMETRICAL SURVEY.

While the State Legislature has overlooked the importance of the map the case has been far otherwise with Congress. By an act passed in 1871, the Coast Survey are authorized to expend a considerable sum of money in extending their triangulations into the interior, but only for those states where a geological survey is in progress. New Hampshire is the only one of the New England states which will receive any benefit from this act, and it is understood that the annual appropriation for this purpose will be $2,000. The work has been placed in the hands of Professors E. T. Quimby and R. Fletcher, of Dartmouth College, who will soon enter the field with their instruments. They will first occupy the stations made use of by Professor Quimby last year, for the benefit of the geological survey, so as to verify their accuracy, and then proceed to new stations. Thus the existence of the geological survey will lead to the expenditure of a considerable sum every year in our midst. As shown further, an expedition was organized last winter in connection with the survey, whose expenditures amounted to $3,500, or the entire sum appropriated for our benefit. As attention was prominently called to the mountains, in consequence of the establishment of the Mount Washington observatory, the summer travel has greatly increased; and hence to say that our organization has been the means, in a single year, of bringing into the state twice the amount of money that it appropriated for it, is understating the actual truth. It is certainly agreeable to us to know that our work is a public benefit in these indirect ways, in addition to the good to be derived from the accomplishment of the result originally anticipated.

MAP OF LYMAN.

The surveying necessary for the mapping of a part of the Ammonoosuc gold field, referred to in our last report, has been completed. The last part of the work, setting the stakes for more than two square miles, was performed under the direction of Professor Quimby. Only office work is now required to draw the map, and show the courses of all the valuable mineral veins existing upon the tract, as well as the remarkable windings and dislocation of the formations which are there exhibited. Not less than five hundred specimens were collected to illustrate this map. The geological part of the work was a separate task. None of the mines have been in active operation during the past year except one, and that has been worked on account of the valuable properties of the gangue rock when pulverized, for a fertilizer. It is the Grafton mine, described in our first report.

MR. HUNTINGTON'S LABORS.

These have been incessant. In the early part of the year, he traversed on foot the various mountain notches between the Saco, Pemigewasset and Connecticut rivers, in order to discover their altitudes as well as their geological character. Next he resumed the examination of the rocks of Coos county. Afterwards he joined our party in the White Mountains, as before mentioned. Later in the season he made further examinations in Coos and in Bean's Purchase. Later in the fall he devoted himself to the interests of the Mount Washington Meteorological Expedition, attending to the completion of the arrangements for occupying the railroad depot as an observatory. The six months from the middle of November to the middle of May were spent by him mostly upon the summit, where he was the leader of the heroic party who risked their lives in behalf of science. When this task was completed he resumed his work upon the geology of Coos county.

COLLECTING MINERALS.

Early in the season arrangements were made by which Rev. C. A. Downs of Lebanon, an accomplished mineralogist, devoted a few weeks to collecting, in behalf of the survey, some of the interesting minerals of New Hampshire. His labors were performed chiefly in the towns of Grafton, Springfield, Richmond, Cornish and Lisbon, and the specimens obtained, whether considered in respect to their beauty or their number, show that better work could not have been done by any other person within the state. He has also presented to the museum of Dartmouth College a great variety of crystals of staurolite and other minerals from the state. His labors have greatly facilitated the work of the survey, as his knowledge of localities, obtained only after years of collecting, enabled him to economize time. No days were lost in exploring unpromising localities.

THE MICROSCOPE.

Recent authors have shown that geological studies are greatly promoted by the use of the compound microscope. Sections of rocks, when placed beneath a magnifying lens, display the particular forms of the constituent minerals much more readily than it is possible to know them by chemical analysis. Our friend Professsor Hall, of Hanover, kindly experimented upon some specimens in this way, and obtained interesting results. A section of the granite from Sunapee, magnified several hundred diameters, showed that the amorphous quartz was traversed by minute threads of some unknown mineral. The view immediately brought to mind the magnificent specimens of transparent quartz, permeated by a net work of hair-like crystals of rutile, obtained by Professor O. P. Hubbard, from a boulder in Hanover, several years since. No further examination has been made of these granites, but the importance to the quarryman of microscopic researches into the structure of our granites was immediately made apparent. If these minute crystals are of an easily decomposing mineral, the value of the stone for building purposes will be impaired. It is better that they should not exist, even if with difficulty disintegrated, for the more complex the assemblage of minerals in a rock, the greater is the opportunity for the beginning of decay.

If some of the granites carry foreign minerals in their intimate constitution, and others do not contain them, it will concern the quarryman, when about to open a new stratum, to know to which class the granite belongs. This question can be answered by the microscope.

In view of the importance of microscopical researches, not only in gaining knowledge of the mineral structure of rocks, but also of the "polishing powder" and other valuable minerals abundant in the state, we have organized a new department of the survey, and secured the services of Professor A. M. Edwards, of New York, one of the most skillful microscopists in the country, to take charge of all the specimens that may be sent to him for examination. He has already examined some of the earthy deposits and furnished drawings of the organisms peculiar to them, and is at work preparing sections of the most important of our granites and other rocks, for examination under the magnifying lens.

FOSSILS IN NEW HAMPSHIRE.

Last October, while examining the limestones of Littleton, fossil corals were discovered. They were quite numerous, though obscure. Intelligence of the discovery was immediately telegraphed to the Dartmouth Scientific Association, who happened to be holding a meeting the same evening. It was announced to them that New Hampshire could no longer be called an *Azoic* state, since she had within her borders a coral reef of Silurian age.

Specimens were sent to E. Billings, F. G. S., Paleontologist of the geological survey of Canada, who recognized the genera *Zaphrentis* and *Favosites*, and perceived the probable equivalency of these limestones with the Helderberg series of Memphremagog. The band of rock is supposed to be the same with the limestones of Dalton and Lancaster, the first towns north of Littleton, and perhaps further north. The fossils have been discovered in two localities, nearly two miles apart, upon what is thought to be the two sides of a synclinal axis. The limestone is underlaid by a quartzite and covered by a clay slate, the latter containing impressions of worm tracks. Thus the means are afforded for determining with precision the age of some of our formations. Though previously announced, this is believed to be the first authentic discovery of fossils in the solid rocks of New Hampshire.

LEVELLING ALONG CONNECTICUT RIVER.

For the sake of a proper understanding of the surface Geology of Connecticut River, it has been thought best to level from the Massachusetts line to Connecticut Lake. The work has been commenced by Gyles Merrill, jr., and S. Q. Robinson, of the class of 1872, C. S. D., Dartmouth College. They have levelled between the line and Walpole. It is hoped that the primary line of levelling may be completed before October.

THE MUSEUM.

Culver Hall, at Hanover, is finally in a condition to receive the specimens that have been collected for the museum of the New Hampshire College of Agriculture and the Mechanic Arts. A large number of them have been placed upon shelves, in cases furnished by the college. A similar collection is ready to be placed at your disposal, in accordance with the act establishing the survey. Attention is called to the case of sections, which will be seen to display to great advantage the stratigraphical structure of the whole state at a birdseye view.

CONCLUSION.

That a sketch of the Mount Washington Expedition may appear with our report, further notice of our geological work is postponed. Besides the special assistants of the year, aid was furnished by Mr. E. A. Phelps, of Sharon, Vt., in the field, and by several students of Dartmouth College, in placing specimens upon the shelves in the museum. Our friends have been numerous in every part of the state, as before, and particular acknowledgments are due to Sylvester Marsh and Capt. J. W. Dodge, of the Mount Washington Railway; E. S. Coe, of Bangor, Maine; American Geographical and Statistical Society, of New York; Dr. T. Sterry Hunt, of Montreal, P. Q.; Professor L. Agassiz, Cambridge, Mass.; A. H. Perry, of Lyndonville, Vt.; Gyles Merrill, St. Albans, Vt.; George A. Merrill, Rutland, Vt.; O. T. Ruggles, of Fitchburg, Mass.; J. A. Dodge, Plymouth; George Stark, Nashua; G. E. Todd, Concord; R. Stewart, Keene; Hon. Onslow Stearns, Concord, and others.

THE MOUNT WASHINGTON EXPEDITION.

With the approval of the state authorities, the Survey undertook to investigate the meteorology of Mount Washington, the highest point of land within the state, for the purpose of contributing something to the solution of the great question, whether science can forecast the state of the weather for hours and days beforehand. As our results are highly satisfactory, and as the matter is not appropriate for the final report, we take the liberty of presenting a sketch of the history and results of this expedition, with certain suggestions that seem of great importance. It should be distinctly understood at the outset, that this expedition, so far as its funds were concerned, was purely a private matter. As nothing of the kind was contemplated in the original act, so it was not possible nor desired to use any of the funds appropriated to geological exploration, for meteorological purposes. The funds requisite were entirely obtained from friends by subscription, the total amount, including the value of materials and other substantial aid furnished, rising as high as $3,500.

EARLY HISTORY OF THE EXPEDITION.

When the geologist and his assistant were traversing Lake Champlain, ten years before the organization of the Survey, the idea of spending the winter on Mount Washington was first suggested. Attempts were unsuccessfully made, shortly afterwards, to organize an expedition for that purpose. The two gentlemen became widely separated in the fall, and the subject was dropped till 1869. At that time they were associated together upon the Geological Survey of New Hampshire, and began to devise means for establishing the elevated observatory. The first attempt ended in failure, and as a substitute the occupation of Moosilauke, in

Benton, during the first two months of 1870, was determined upon. A few words respecting this brief visit were presented with our previous report, though nothing was said as to why it was undertaken. It was a wise Providence by which the occupation of Mount Washington was prevented so early, since a whole winter's preliminary experience upon a less elevated summit was needed to indicate the meteorological phenomena peculiar to the higher New England summits in the winter. We demonstrated the possibility of living upon a mountain summit through the winter, and discovered that the violence of the wind was unparalleled while the cold was not so very remarkable.

With this information acquired, we resolutely and determinately set at work to raise the necessary funds. Unexpectedly the use of the house at the summit was denied us. Hearing of the proposed erection of a railway depot at the summit, a letter was addressed to Sylvester Marsh, of Littleton, President of the Railway Company, inquiring whether the house might not be used in the winter by the meteorological party. In reply, it was stated that the completion of the house before winter was uncertain, but a desire was expressed that our enterprise might be successful, Interviews were had with Mr. Marsh, and he spoke even more favorably than we had been led to expect by his letter, but he added that he had not the authority to speak for the company. Having no reason to suppose the directors would not favor us, late in July the State Geologist issued a circular, stating the importance of establishing a meteorological observatory upon Mount Washington in the winter, and asking the friends of scientific research and mountain exploration to contribute the sum of two thousand dollars to maintain the expedition, and furnish the means of telegraphic communication between the observers and the public.

The circular suggested that, with such a sum, the expedition could be made successful, and the public could daily learn the character of the arctic phenomena peculiar to the summit, and that without waiting months or years for the return of the party to civilized regions. It was promised that the funds subscribed should not be called for before October 1, nor then unless the whole amount had been subscribed, and every contributor of ten dollars and upwards was to receive a pamphlet describing the history and results of the expedition. This circular was sent to friends, and small sums were received, but not to any promising extent. Both of us were so occupied with necessary field work that we had no time to beg for money. Circulars were posted at the principal hotels among the mountains, in full view of the guests, but they did not excite any special interest.

THE SIGNAL SERVICE.

It was now the first of September, and not a hundred dollars had been promised. Our next effort was in the direction of the press. A prominent journal in New York was willing to give us five hundred dollars, for daily telegrams and occasional letters sent to them exclusively, during the winter months. Although a telegraph line, capable of use in the winter months, was beyond our expected means, our faith in ultimate success was strengthened by this proposal. About this time our attention was called to the recent establishment of the "Bureau of Telegrams and Reports for the Benefit of Commerce," in connection with the War Department at Washington. Application was made to General A. J. Myer, the Chief Signal Officer, for funds to aid us in carrying out our enterprise, while allowing the weather office to share its benefits. The answer, dated September 14, stated that the Chief Signal Officer could "hardly appropriate money for the object named; but it may be in the power of this office, with the approval of the Secretary of War, to detail an observer for the position you propose to occupy."

In answer to two additional communications from the State Geologist, dated September 21 and 22, the Chief Signal Officer states his willingness to provide an insulated telegraph wire, to extend from the summit of Mount Washington to the railroad station at its base, but that he can not sanction any special arrangement that has been made to furnish any one paper exclusively with the weather reports. He proposed himself to furnish weather reports from all the stations throughout the country to the principal newspapers, as well as to the Chambers of Commerce, and could not well omit any one. He also offered to provide the meteorological instruments required for the station. Thus the means were provided for sending daily telegrams, but it necessitated the annulling of the contract for sending the weather reports exclusively to the New York newspaper, and left us as poor as ever.

In a letter of October 7, the Chief Signal Officer announces that he has sent to the State Geologist three miles of insulated Kerite telegraph wire, two telegraph instruments, two sections and four conductors, to the value of ten hundred and thirty-two dollars; and that an instructed observer will probably be detailed to join the expedition. These telegraph supplies were duly received and immediately transported to the mountain.

MR. NELSON.

From another quarter, however, there came the required assistance. In the month of July, Mr. Durgin of the Sinclair House in Bethlehem, informed Professor Hitchcock that a relative of his by marriage, S. A. Nelson of Georgetown, Massachusetts, was very much interested in the meteorology of Mount Washington, and would like to join our expedition. Mr. Nelson wrote by date of July 28, presenting a request to be permitted to join the expedition, asking also for further information. It appeared that he had been led naturally to think of the great benefits to science that must accrue from the occupation of our highest mountain for meteorological purposes, and he had determined, if not able to go with some party, to attempt the enterprise "alone in the face of all hardships and dangers." His letters had the ring of the true metal in them, and an interview for the exchange of views was requested. Circumstances prevented our meeting. By further correspondence, it appeared that Mr. Nelson was ready to devote himself to raising funds for the expedition, in case he could be one of the party. A formal invitation was soon extended to Mr. Nelson to cast in his lot with us. He accepted, and immediately set himself to the task of soliciting subscriptions in eastern Massachusetts, pledging himself to procure at least five hundred dollars. His promise was more than realized, for his efforts brought in more than eight hundred dollars. His labors commenced early in September, and he did not go upon the mountain till late in December, remaining behind after the occupation of the summit to complete what he conceived to be his part of the work below.

OVERCOMING DIFFICULTIES.

It became evident that the public were slowly gaining confidence in the success of our enterprise, and therefore we began to purchase our supplies. Mr. Huntington made out the list, that we might have the needful articles at the lower mountain depot early in October, understanding that the trains could not transport freight for us before that time. On the 19th of September, word was sent to Professor Hitchcock, at Bethlehem, that the mountain trains would stop running on the following day, as the track was to be taken up immediately for repairs, and that no orders had been given by the officers of the company to afford our expedition any facilities, either of transportion or the use of the summit depot; that this building had been left unfinished, there being only roof and sides, without doors or windows; that the cold weather having set in, it would soon be impossible to run the trains for want of water, etc. To add to these difficulties the supplies had not all been purchased; it was uncertain whether sufficient funds could be obtained, and no arrangement had then been made for the use of a telegraph cable.

Under these unpromising circumstances the party at Bethlehem, with the exception of the State Geologist, came unanimously to the conclusion that the obstacles in the way were insurmountable, and the expedition must be abandoned for the next winter. But he said the supplies should all go up the mountain, even if he turned teamster himself, and with a single horse transported them up the carriage road; Mr. Huntington having expressed a willingness to remain upon the summit all winter even without telegraphic communication with the world below. The next day, therefore, one of the party went to the railroad station to say that orders were coming from headquarters to grant the needed facilities, as they must have been delayed by some misunderstanding. Another went to Littleton to borrow a few tons of coal, so that the most essential article to comfort might be sure to reach the railroad in season for transportation to the summit. Professor Hitchcock at the same time went to Boston, and obtained from the officers of the company the necessary permission to use their summit depot during the winter; and immediately transmitted it to the employees. The railway company generously gave us the use of the depot, and transported our supplies over their line to the summit without charge, and regretted that they could not have known earlier of our purpose, so that the house might have been completed. Our thanks are specially due to the engineers, Mr. Charles L. Aiken and Mr. Kidder, for remaining on the mountain longer than was necessary for their own purposes, to accommodate us.

Immediately after Professor Hitchcock's return, Mr. Huntington went to Boston, to select the necessary supplies in connection with Mr. Nelson, and to see that they were forwarded without delay. These necessaries were purchased on credit and the amounts charged to Professor Hitchcock. They were immediately forwarded and transported to the summit.

In spite of all our efforts the telegraphic apparatus sent from Washington, and some other necessary articles, arrived too late for the last train, and these were taken around the mountain in a buggy, partly by Professor Hitchcock and partly by Mr. Huntington, and thence to the summit on the carriage road. The distance traversed by each was nearly eighty miles, over a very muddy and hilly route. The road up the mountain had been closed for the winter, and the fifty or sixty bridges upon it taken up, so that in addition to the labor of climbing, the planks must be relaid. Several days were spent upon the summit in preparing the building for occupation — partitioning off a room, setting up the stoves, laying double-floors, etc. In this we were aided by a carpenter from Berlin Falls. On the eighteenth of October, Professor Hitchcock attempted to carry up the last supplies of beef and mutton, but at the Half-way House the wind was blowing at the rate of sixty or seventy miles per hour, and it was not prudent to venture further with a horse. The load was left at the turning point, and was subsequently carried to the summit by Mr. Huntington, who remained on the mountain till the rooms were completed for occupation, the Kerite wire laid, and everything was in readiness for the incoming of the party. He came down October 22.

A NEW CIRCULAR.

In the latter part of October, Professor Hitchcock joined Mr. Nelson for a few days in the work of soliciting funds. A new circular, adapted to the changed circumstances, was prepared, and was widely distributed. In this it was briefly stated that the arrangements for the occupation of the mountain had been completed; the observers, photographers and telegrapher selected;

the needful supplies purchased and transported to the summit; a Kerite telegraph wire had been laid over that portion of the route where a common wire could not withstand the wintry blasts and accumulations of ice; that the building had been secured and comfortably furnished, and furthermore that the party intended to establish themselves in their snug eyrie about the twelfth of November.

Reference was made to the approval of the expedition by the War Department, and to a special letter of recommendation signed by Professors B. Pierce, Joseph Winlock, Joseph Lovering, Asa Gray, Alpheus Hyatt, President Runkle, N. B. Shurtleff, and William Claflin.

It was also thought that commerce would be greatly benefited by our daily reports. As the farmer studies the cloud-caps upon high mountains to forecast the weather, so telegraphic reports of the condition of the atmosphere upon the highest summit in eastern America would enable ship-owners to judge of the approach of storms, and escape risk of loss to their vessels by keeping them in a harbor until the danger was past; so too, with fair weather reported from the mountain, vessels could get a day's start of any bad spell of weather, and thus escape great peril.

It was announced that these preparations had been made with the expectation that friends would contribute funds sufficient to meet the expenses. Should the public fail to appreciate the enterprise, the burden would fall upon the State Geologist, who had already paid out seven hundred dollars more than the amount of the subscriptions.

This appeal proved to be efficacious, as in consequence of this and other applications, enough funds were secured to pay all the bills of the expedition. It was hoped that there might be a small balance in our favor, so that the observers might preserve some reminder of their wild experiences; but they are all well satisfied that the expedition has been able to meet its obligations without protestation.

OUR TELEGRAPHER.

On the third of November the Chief Signal Officer informed us that he would send an instructed operator and observer, with a complete set of meteorological instruments, to Mount Washington, and requested that one weather report might be forwarded to him daily by telegraph. This report would be bulletined along with those from other stations, and a copy of it furnished to the principal daily journals in the country. After some delay, Sergeant Theodore Smith, U. S. A., started from Washington, and reached the mountain early in December.

MEMBERS OF THE EXPEDITION.

The complete organization of the expedition is as follows:

C. H. Hitchcock, State Geologist, with office in Hanover, connected by telegraph with the summit of Mount Washington.

J. H. Huntington, Assistant State Geologist, in charge of the Observatory upon the mountain.

S. A. Nelson, Observer.

A. F. Clough and H. A. Kimball, Photographers.

Theodore Smith, Observer and Telegrapher for the Signal Service.

EARLIER WINTER VISITS.

Only two earlier visits to the summit are known to have been made. The first was by Sheriff Osgood, of Lancaster, December 7, 1858, and the other by J. H. Spaulding and a few friends, February 11, 1862. Both trips were regarded as hazardous in the extreme, and their escape from the "frost clouds" were regarded as very fortunate.

Our expedition was undertaken in the face of all previous experience about Mount Washington. Failure was universally predicted. Very few words of encouragement were offered to us, and a great many were offered to dissuade us from our undertaking. Scarcely any one seemed to appreciate the advantages to be derived from the winter's occupation, even if the parties themselves became martyrs to science. But our efforts have clearly proved that persons may spend the winter upon the summit of Mount Washington and not be deprived of a weekly mail; and as the views obtained in the cold season are remarkably fine, and other interesting phenomena show themselves, it is safe to predict that it will soon become a common thing for adventurous tourists to make winter visits to this summit.

THE ASCENT IN WINTER.

The ascent in winter may be fatal to feeble persons, or those whose vitality has been exhausted by climbing. Exhaustion is more easily induced than in summer, on account of the severe winds and cold. There have been nearly a hundred ascents of the mountain during the six months' sojourn of the party, several of them, however, made with great difficulty. No one that has attempted the ascent has failed to accomplish his purpose. Of the party of four who went up November 30, Mr. H. A. Kimball of Concord nearly perished from exhaustion and cold with the thermometer at 7° Fahrenheit, and the wind blowing at the rate of seventy miles an hour. The ascent under the greatest difficulties was that of April 5, by A. F. Clough of Concord and C. B. Cheney of Orford. The wind blew over eighty miles an hour, while the temperature was nearly at zero. They were badly frost-bitten, though not seriously so. They succeeded in reaching the summit on account of their superior powers of endurance. Most persons would have perished.

Register of Ascents and Descents between Nov. 12, 1870, *and May* 14, 1871.

November 12th, ascent by J. H. Huntington; 16th, descent and ascent by J. H. Huntington; 18th, ascent by Francis Richardson, Lancaster, N. H., and W. A. Richardson, West Concord, Vt.; 19th, descent by the Messrs. Richardson; 23d, descent and ascent by J. H. Huntington; 26th, descent to Marshfield and return by J. H. Huntington; 30th, ascent by C. B. Cheney, Orford, N. H., C. F. Bracy, Warren, N. H., and by Messrs. Clough and Kimball.

December 4th, descent of Messrs. Cheney and Bracy, ascent by Sergeant Theodore Smith; 5th, descent to Marshfield by J. H. Huntington; 11th, ascent by J. H. Huntington, descent and ascent A. F. Clough; 12th, descent and ascent by Messrs. Clough and Smith; 19th, J. H. Huntington descends to Marshfield; 21st, ascents by C. H. Hitchcock and L. B. Newell, Hanover, E. Thompson, North Danville, Vt., S. Aug. Nelson, Georgetown, Mass., Frank Woodbridge, Newark, Ohio, (the first two returned the same day, Thompson and Woodbridge two days later); 27th, descent and ascent by A. F. Clough.

January 2d, Clough and Kimball descended; 12th, return of J. H. Huntington to the summit, with G. A. Miller, Concord, N. H.; 15th, descent of G. A. Miller; 26th, descent and ascent by Huntington; 28th, W. E. Higgins, Chicago, Ill., and S. Q. Robinson of Boston, ascended; 29th, Higgins and Robinson returned down.

February 1st, descent and ascent by Huntington; 7th, descent and ascent by Huntington; 8th, descent by Huntington, and subsequent ascent in company with L. L. Holden of Boston, and P. B. Cogswell of Concord, N. H., and A. F. Clough; 12th, descent by Messrs. Huntington, Clough, Holden and Cogswell; 17th, ascent and return the same day of Walter Aiken, Charles L. Aiken and George C. Proctor, of Franklin, N. H., and Michael Mularvey, Marshfield; 19th, ascent and descent by Battiste Rousseau, Wheaton, P. Q.

March 1st, Edward L. Wilson, Philadelphia, B. W. Kilburn, Littleton, N. H., and Michael Mularvey ascended (they returned March 2d); 5th, from Glen House there came up and returned, Sylvester Wright, Frederick Church, Marshall Desprey and Joseph Nolan; 7th, ascent by J. H. Huntington, G. O. Rogers and Oliver Nutter of Lancaster, N. H., (the two last went down in a day or two); 8th, ascent and descent by B. W. Kilburn and John Mularvey, St. Sylvester, P. Q.; 14th, ascent by Kilburn, ascent and descent by James McCourt, St. Sylvester, P. Q.; 16th, descent and ascent by Kilburn; 19th, J. H. Huntington descends; 20th, descent and ascent by Nelson and Kilburn; 26th, A. F. Clough and Mr. Mularvey ascend, the latter returning; 27th, descent by Kilburn; 28th, ascent and descent by Kilburn and John Mularney.

April 2d, A. F. Clough descends; 5th, Messrs. Clough and Cheney ascend; 7th, J. H. Huntington and I. N. Andrews of Boston, ascend; 9th, Messrs. Clough, Cheney and Andrews descended; 19th, descent and ascent by Nelson; 25th, J. H. Huntington descended; 26th, ascents by C. H. Hitchcock, E. C. Burbeck and Alonzo Hall, (the last returned the same day); 29th, Burbeck descended, meeting J. H. Huntington and L. L. Holden and E. Thompson ascending.

May 1st, C. H. Hitchcock descends, Frank McCourty, of Marshfield, ascends and returns the next day; 9th, Messrs. Holden and Thompson went down; 12th, Sergeant Smith descended; 14th, J. H. Huntington descended.

This makes a total of seventy ascents and sixty-nine descents, during the time of our occupation of the summit, and most of them in months when an ascent or descent of Mount Washington is commonly supposed to be impossible. The number of persons making these ascents was thirty-eight. Mr. Huntington went up thirteen times.

METEOROLOGICAL RECORD.

Great pains were taken to secure a meteorological record. From November 12 to May 14, observations were taken three times a day by Mr. Huntington, at 7 A. M., 2 and 9 P. M. In the absence of Mr. Huntington, these observations were taken either by Mr. Nelson or Sergeant Theodore Smith, and the entire record to May 14 has been transmitted to Washington. With the opening of telegraphic communication, December 14, till May 14, an observation was taken daily at 7 P. M., and transmitted to the Associated Press. On special occasions additional observations for the press were sent in the morning or at noon. At first only one set of observations was sent to the Signal Service Department, but after January 1, 1871, three were sent daily by telegraph to Washington, viz: at 7:57, A. M., 4:57 and 10, P. M. These have been continued daily since the breaking up of the expedition, for the benefit of the Signal Service Department, and they are often published in the daily journals. The observations for the benefit of the government were taken and sent by Sergeant Smith.

Mr. Huntington occupied the mountain alone for nearly three weeks, and was upon the mountain one hundred and eighty-three days in all. Sergeant Smith was present one hundred and fifty-nine. S. A. Nelson was present one hundred and forty-five, and remained there more than six weeks after the breaking up of the expedition.

The instruments used were standard thermometers and barometers, hygrometer, anemometer and wind-vane. Observations were recorded of the temperature without and within, height of barometer, the relative humidity of the atmosphere, the force and direction of the wind, the character, amount and motion of the clouds, facts about rain, snow and ice. So far as possible this record is herewith presented, and the additional observations to the first of July, most of those in the month of June taken by Sergeant

Hearn, U. S. A., who relieved Sergeant Smith. With them are presented observations taken for purposes of comparison by E. S. Mason, in Gorham, Dr. H. A. Cutting, in Lunenburg, Vt., and those taken by Mr. Hazen, under the direction of Professor C. A. Young, at the Observatory of Dartmouth College. The barometrical observations have all been reduced to the freezing point, and then to the level of the sea, so that the reader may compare them without making these calculations for himself.

METEOROLOGICAL REGISTER.

BAROMETER REDUCED TO THE LEVEL OF THE SEA, AT 32°.—NOVEMBER 13–30, 1870.

Day of Month.	Mt. Washington 7 o'clock A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington 7:57 A. M.	Mt. Washington 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham. 2 P. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Lunenburg, 9 P. M.	Hanover, 9 P. M.	Gorham, 9 P. M.	Mt. Washington, 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
13	29.859	29.70	29.691	......	......	29.726	29.64	29.669	.....	.....	.....	29.475	29.69	29.738	.....	.....	29.721	29.68	29.699	....
14	.593	29.70	29.785	......	......	.633	.65	29.673	.....	.....	.....	.619	.59	.610	.....	.....	.615	.65	.689	....
15	.591	.66	.737	29.47	......	.659	.75	.760	29.55	.....	.....	.730	.75	.808	.....	.....	.660	.72	.735	29.51
16	.763	.82	.920	.65	......	.766	.94	.948	.73	.....	.....	.883	30.01	30.098	29.91	.....	.804	.92	.988	.76
17	.890	.92	30.215	.95	......	.997	30.07	30.136	.93	.....	.....	.988	.01	.126	.....	.....	.958	30.00	30.159	.94
18	.959	30.02	.093	.85	......	.847	29.97	29.947	.79	.....	.....	.781	29.80	29,861	.....	.....	.892	29.93	29.967	.82
19	.609	29.70	29.786	.49	......	.475	.61	.683	.....	.....	.....	.453	.65	.751	.....	.....	.512	.65	.740	....
20	.722	.97	30.022	......	......	.778	.92	30.018	.....	.....	.....	.841	.91	.983	.....	.....	.780	.93	30.008	....
21	.856	.92	.016	.71	......	.795	.92	29.982	.....	.....	.....	.806	30.16	30.200	.....	.....	.819	30.00	.066	....
22	30.158	30.36	.465	30.43	......	30.160	30.26	30.387	30.45	.....	.....	30.070	.16	.198	30.15	.....	30.129	.26	.350	30.34
23	29.701	29.66	29.639	29,51	......	29.499	29.51	29.547	29.35	.....	.....	29.419	29.55	29.630	.....	.....	29.540	29.57	29.605	29.43
24	.317	.70	.792	.47	......	.391	.81	.828	.57	.....	.....	.590	.92	.987	.....	.....	.433	.81	.869	.52
25	.896	.86	30.063	.77	......	.893	.87	.940	.73	.....	.....	.863	.72	.824	.....	.....	.877	.82	.942	.75
26	.778	.56	29.602	.37	......	.484	.61	.524	.27	.....	.....	.596	.59	.670	.....	.....	.619	.59	.599	.32
27	.560	.60	.674	......	......	.568	.80	.659	.....	.....	.....	.733	.90	.907	.....	.....	.620	.76	.747	....
28	.881	30.06	30.159	.87	......	30.003	30.11	30.144	30.01	.....	.....	30.089	30.15	30.193	.....	.....	30.324	30.11	30.165	.94
29	.996	.07	.121	.95	......	29.950	.01	.053	29.91	.....	.....	29.911	.05	.156	.....	.....	29.952	.08	.110	.93
30	.904	.25	.332	30.05	......	.923	.21	.314	30.11	.....	.....	.958	.21	.212	.....	.....	.928	.22	.286	30.08
																	29.778	29.87	29.985	29.78

BAROMETER REDUCED TO THE LEVEL OF THE SEA, AT 32°.—DECEMBER, 1870.

Day of Month.	Mt. Washington, 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P.M.	Hanover, 2 P. M.	Gorham, 2 P. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Lunenburg, 9 P. M.	Hanover, 9 P. M.	Gorham, 9 P. M.	Mt. Washington, 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	29.748	29.95	30.071	29.72	......	29.681	29.77	29.875	29.58	.....	.....	29.564	29.73	29.786	.....	.....	29.664	29.82	29.911	29.65
2	.464	30.04	29.654	.38	......	.439	.57	.579	.36	.....	.....	.431	.57	.584	.....	.....	.444	.73	.606	.37
3	.553	29.80	.836	.56	......	.569	.84	.912	.54	.....	.....	.779	.84	.911	.....	.....	.633	.83	.886	.55
4	.707	.75	.867	......	......	.763	.74	.755	.....	.....	.....	.737	.79	.850	.....	.....	.735	.76	.824	....
5	.906	.94	30.010	.76	......	.860	.88	.931	.78	.....	.....	.686	.77	.769	.....	.....	.817	.86	.906	.77
6	.569	.70	29.542	.36	......	.569	.53	.547	.34	.....	.....	.496	.67	.717	.....	.....	.544	.63	.606	.35
7	.708	.95	.966	.66	......	.805	.88	.921	.70	.....	.....	.803	.83	.870	.....	.....	.772	.89	.919	.68
8	.665	.69	.715	......	......	.635	.69	.673	.....	.....	.....	.669	.73	.790	.....	.....	.656	.70	.726	....
9	.716	.85	.986	.70	......	.798	30.04	30.087	.82	.....	.....	.878	30.10	30.186	.....	.....	.797	30.00	30.086	.76
10	.800	30.11	30.179	.80	......	.779	.10	.136	.92	.....	.....	.965	.20	.307	.....	....	.848	.14	.208	.86
11	30.199	.36	.439	30.18	......	30.284	.39	.497	30.20	.....	.....	.302	.40	.458	.....	.....	.561	.38	.495	30.19
12	.185	.26	.400	.18	......	.067	.14	.250	.14	.....	....	.987	·09	.149	.....	.....	.746	.16	.266	.16
13	29.907	29.94	30.008	29.78	......	29.808	29.88	29.903	29.70	.....	.....	.760	29,78	29.855	.....	.....	.825	29.87	29.922	29.74
14	.621	.69	.710	.46	......	.410	.63	.620	.36	.....	29.405	.361	.61	.625	.....	.....	.464	.64	.652	.41
15	.353	.66	.645	.30	......	.192	.65	.709	.....	.....	.187	.029	.71	.770	.....	.....	.191	.67	.708	....
16	.951	.77	.809	.36	......	.233	.81	.873	.54	.....	.311	29.415	.87	.955	.....	.....	.533	.82	.879	.45
17	.521	.86	.996	.58	......	.673	.80	.875	.52	.....	.500	29.468	.71	.754	.....	.....	.554	.79	.875	.55
18	.303	.61	.646	......	......	.398	.71	.748	.....	.....	.346	.475	.81	.804	.....	.....	.392	.71	.733	....
19	.542	.97	30,085	.56	......	.777	.96	20.037	.80	.....	.822	.792	.86	.961	.....	.....	.703	.93	30.027	.68
20	.463	.51	29.526	.44	......	30.268	.51	29.435	.16	.....	.303	.308	.50	.533	.....	.....	.679	.51	29.498	.30
21	3.343	.55	.509	.26	......	29.428	.69	.745	.48	.....	.422	.495	.80	.965	.....	.....	.422	.68	.740	.37
22	.574	30.01	30.132	.76	......	.639	30.06	30.157	.84	.....	.630	.635	30.06	30.176	....	.....	.616	30.04	30.155	.80
23	.665	29.97	.096	.74	......	.574	29.92	29.981	.....	.....	.517	.515	29.88	29.939	.....	.....	.584	29.92	.006	...
24	.319	.87	29.963	......	.....	.359	.97	.924	.....	.....	.407	.433	30.03	30.105	.....	.....	.337	.96	29.998	....
25	.643	30.25	30.346	......	......	.781	30.33	30.412	.....	.....	.858	.911	.33	.414	.....	.....	.778	30.30	30.391	....
26	.734	.18	.207	......	......	.591	29.99	.059	.....	.....	.606	.626	29.96	.090	.....	.....	.650	.04	.089	....
27	.719	.06	.184	......	......	.707	.96	.074	.....	.....	.667	.628	.89	29.987	.....	.....	.684	29.97	.082	....
28	.601	29.86	29.927	......	......	.686	.80	29.885	.....	.....	.694	.693	.84	.892	.....	....	.660	.83	29.902	....
29	.437	.66	.711	......	......	.303	.63	.693	.....	.....	.327	.520	.78	.883	.....	.....	.420	.69	.763	....
30	.650	.95	30.052	......	......	.665	.87	.993	.....	.....	.634	.573	.83	.881	.....	.....	.629	.88	.976	....
31	.538	.64	29.698	......	......	.534	.69	.666	.....	.....	.....	.476	.73	.756	.....	.....	.516	.69	.707	....
																	29,608	29.89	29.922	29.65

BAROMETER REDUCED TO THE LEVEL OF THE SEA, AT 32°—JANUARY, 1871.

Day of Month.	Mt. Washington, 7. A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham, 2 P. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Lunenburg, 9 P. M.	Hanover. 9 P. M.	Gorham, 9 P. M.	Mt. Washington, 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	29.460	29.94	30.112	......	29.456	29.468	29.98	30.004	....	29.498	29.511	29.668	30.03	30.044	.....	29.677	29.533	29.98	30.020	....
2	.665	.86	29.977	29.70	.660	.402	.86	29.668	29.54	.382	.324	.373	29.70	29.806	.....	.367	.453	.81	29.817	29.62
3	.382	.95	30.088	.68	.475	.586	.89	.963	.72	.680	.568	.608	.89	30.002	.....	.401	.557	.91	30.018	.70
4	.613	30.16	.292	.92	.605	.644	30.20	30.292	30.03	.677	.726	.704	30.26	.353	.....	.671	.663	30.21	.312	.98
5	.754	.12	.250	.88	.721	.654	29.89	29.953	29.72	.620	.628	.553	29.80	29.792	.....	.790	.703	29.93	29.998	.80
6	.654	29.77	29.781	.50	.649	.615	.76	.766	.54	.676	.580	.589	.86	.896	.....	.524	.612	.80	.814	.52
7	.559	30.05	.979	.78	.551	.642	30.09	30.194	.92	.679	.760	.762	30.20	30.302	.....	.763	.675	30.11	30.158	.85
8	.759	.19	30.296	.90	.616	.705	.16	30.195	.74	.716	.....	.751	.19	.253	.....	.744	.715	.18	.248	.82
9	.772	.22	.334	.92	.608	.757	.25	.335	30.03	.789	.780	.796	.31	.398	.....	.797	.757	.26	.356	.98
10	.797	.34	.428	30.00	.623	.782	.21	.260	29.98	.786	.800	.851	.17	.269	.....	.845	.783	.24	.319	.99
11	.811	.13	.272	29.90	.632	.908	.10	.167	.90	.906	.940	.785	.16	.242	.....	.993	.853	.13	.227	.90
12	30.209	.35	.389	30.10	30.219	30.286	.37	.434	30.23	30.314	30.360	30.428	.47	.534	.....	30.624	30.348	.40	.452	.16
13	.463	.54	.599	.38	.442	.460	.51	.550	.....	.453	.430	.418	.50	.552	.....	.396	.437	.52	.567	....
14	.384	.51	.552	......	.349	.378	.45	.470	.....	.389	.400	.402	.45	.534	.....	.399	.385	.47	.519	....
15	.290	.41	.481	.32	.286	.095	.30	.351	.....	.064	.....	.002	.10	.220	.....	29.959	.116	.27	.351	....
16	29.912	29.96	29.968	.74	29.896	29.809	29.90	29.813	.....	29.796	29.760	29.728	29.80	29.877	.....	.718	29.831	29.89	29.886	....
17	.503	.92	30.027	.68	.504	.688	30.07	30.092	29.86	.759	.770	.768	30.13	30.225	.....	.746	.675	30.04	30.115	.77
18	.729	30.40	.361	30.17	.749	.993	.50	.496	30.26	30.031	30.060	30.157	.55	.661	.....	30.158	.982	.48	.506	30.22
19	30.260	.67	30.803	.42	30.255	.872	.66	.725	.46	.287	.280	.285	.57	.718	.....	.278	30.216	.63	.749	.44
20	.168	.48	.597	.24	.163	.040	.35	.371	.12	.006	29.990	29.979	.28	.240	.....	29.967	29.901	.37	.403	.18
21	29.805	29.98	.026	29.72	29.779	.678	29.77	29.804	29.56	29.550	.760	.430	29.62	29.665	.....	.440	.633	29.79	29.832	29.64
22	.155	.70	29,675	......	.134	28.944	.73	.843	.....	.169	.....	.050	.97	30.111	.....	.178	.273	.80	.876	....
23	.338	30.30	30.342	.72	.350	29.692	30.28	30.385	30.02	.763	.800	.870	30.28	.399	.....	.816	.752	30.29	30.375	.87
24	.809	.33	.363	30.02	.807	.746	.16	.258	30.00	.719	.730	.732	.20	.302	.....	.724	.612	.23	.308	30.01
25	.589	.36	.449	29.92	.587	.690	.56	.601	.42	.765	.....	.817	.67	.810	.....	.826	.712	30.53	.620	.17
26	30.051	.62	30.794	30.36	30.078	.983	.50	.588	.34	.941	.870	.827	.31	.382	.....	.835	.655	.48	.588	.35
27	29.653	30.10	.069	29.32	29.630	.337	29.89	29.932	29.62	.344	.360	.448	.04	.102	.....	.476	.465	30.01	.034	29.47
28	.586	.20	.313	30.02	.611	.858	30.20	80.290	30.04	.822	.740	.883	.26	.336	.....	.787	.754	.22	.313	30.03
29	.765	.17	.226	29.92	.775	.717	.11	.111	29.72	.732	.....	.723	.06	.139	.....	.699	.733	.11	.159	29.82
30	.809	.19	.238	.84	.822	.970	.24	.269	30.06	.985	.991	.980	.22	.262	.....	.975	.931	.22	.256	.95
31	.917	.07	.144	.82	.908	.759	29.85	29.902	29.70	.677	.620	.626	29.70	29.756	.....	.544	.721	29.87	29.934	.76
																	28.786	30.16	30.230	29.88

BAROMETER REDUCED TO THE LEVEL OF THE SEA, AT 32°.—FEBRUARY, 1871.

Day of Month.	Mt. Washington, 7 o'clock A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham, 2 P. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Lunenburg, 9 P. M.	Hanover, 9 P. M.	Gorham. 9. P. M.	Mt. Washington, 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	29.620	29.84	29.825	29.50	29.615	29.802	29.93	29.992	29.78	29.865	29.940	29.909	30.04	30.087	.....	29.898	29.807	29.94	29.968	29.64
2	.857	.98	30.090	.70	.852	.623	.79	.848	.58	.955	.440	.263	29.54	29.630	.....	.294	.612	.77	.856	.64
3	.044	.78	29.857	.48	.159	.017	.58	.566	.26	.108	.039	.071	.38	.365	.....	.112	.077	.58	.596	.37
4	.752	.51	.686	.24	28.762	28.896	.71	.849	.44	28.942	28.877	28.939	.88	.976	.....	28.936	28.858	.70	.837	.34
5	.172	.99	30.118	.60	29.268	29.295	30.02	30.134	.54	29.458	.....	29.520	30.08	30.118	.....	29.514	29.318	30.03	30.123	.57
6	.656	30.06	.162	.60	.664	.719	.10	.169	.84	.793	29.840	.921	.25	.279	.....	.946	.791	.14	.203	.72
7	.041	.36	.438	30.00	30.048	30.052	.29	.399	30.10	.052	30.080	30.081	.28	.365	.....	30.087	30.062	.31	.401	30.05
8	.810	.24	.313	30.00	.005	29.915	.14	.226	.02	.952	29.950	29.940	.09	.155	.....	29.937	29.787	.16	.231	.01
9	.651	29.93	29.968	29.70	29.798	.651	29.85	29.794	29.58	.529	.....	.553	29.74	29.775	.....	.548	.635	29.84	29.845	29.64
10	.454	.86	.953	.58	.443	.328	.88	.996	.98	.340	29.347	.334	30.09	30.192	.....	.322	.367	.94	30.047	.78
11	.482	30.30	30.410	30.08	.496	.692	30.29	30.405	30.10	.702	.....	.808	.35	.408	.....	.828	.668	30.31	.408	30.09
12	.884	.21	.388	30.00	.882	.726	.09	.101	29.80	.661	.....	.607	29.90	29.892	.....	.608	.718	.07	.127	29.90
13	.645	.04	30.088	29.62	.639	.758	.13	.170	.96	.803	.840	.894	30.23	30.278	.....	.892	.781	.13	.179	.79
14	.866	.20	.295	.90	.857	.778	.08	.122	.90	.729	.730	.743	29.98	.059	.....	.870	.896	.09	.159	.90
15	.790	.14	.242	.90	.777	.910	.16	.243	30.00	.931	.940	.919	30.07	.134	.....	.492	.823	.07	.206	.95
16	.666	29.83	29.919	.60	.657	.525	29.67	29.714	29.48	.466	.460	.504	29.76	29.851	.....	.930	.599	29.75	29.828	.54
17	.743	.92	30.163	.72	.741	.935	30.11	30.211	.98	.940	.950	.940	30.06	30.102	.....	.945	.885	30.03	30.159	.85
18	.406	.48	29.693	.48	.395	.105	29.52	29.204	29.00	30.141	.....	.108	29.77	29.418	.....	.232	.233	29.59	29.438	.24
19	.479	.83	.910	.62	.479	.569	.84	.916	.54	29.566	.....	.578	.88	.903	.....	.525	.532	.85	.909	.58
20	.611	30.09	30.011	.60	.593	.630	30.13	30.030	.76	.648	.....	.658	30.13	30.144	.....	.658	.634	30.12	30.062	.68
21	.729	.29	.242	.92	.723	.774	.30	.276	30.00	.885	.800	.832	.30	.388	.....	.840	.797	.30	.302	.96
22	30.017	.28	.568	30.14	30.003	30.027	.22	.549	.26	30.061	30.070	30.037	.16	.578	.....	30.100	30.045	.22	.565	30.20
23	.158	.12	.615	.28	.050	.216	.04	.471	.30	.215	.190	.203	.01	.417	.....	.203	.176	.06	.501	.29
24	.100	29.95	.246	.28	.095	.004	29.73	.012	.08	29.924	29.860	29.815	29.64	29.850	.....	29.811	29.516	29.77	.036	.18
25	29.585	.66	29.734	29.40	29.579	29.501	.73	29.672	29.50	.521	.....	.594	.78	.846	.....	.588	.561	.72	29.751	29.45
26	.675	.80	.894	.64	.669	.735	.78	.811	.58	.658	29.700	.635	.74	.699	.....	.635	.673	.77	.801	.61
27	.377	.44	.435	.10	.370	.190	30.34	.367	29.09	30.147	.200	.224	.59	.635	.....	30.220	.247	.46	.479	.09
28	.479	.92	30.015	.70	.468	.729	.06	30.134	.90	29.752	.830	.873	30.07	30.163	.....	29.863	.713	30.02	30.104	.80
																	29.633	29.95	30.040	29.74

BAROMETER REDUCED TO THE LEVEL OF THE SEA, AT 32°—MARCH, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham, 2 P. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Lunenburg, 9 P. M.	Hanover, 9 P. M.	Gorham, 9 P. M.	Mt. Washington, 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	29.596	29.67	29.788	......	29.59	29.482	29.61	29.677	.....	29.50	29.58	29.674	29.84	29.985	.....	29.67	29.577	29.71	29.817	....
2	.925	30.16	30.217	......	.92	.957	30.05	30.131	.....	.91	.81	.908	.89	30.002	.....	.90	.904	30.03	30.117	....
3	.696	29.65	29.744	......	.68	.525	29.49	29.518	.....	.55	.60	.569	.75	29.786	.....	.56	.597	29.63	29.649	....
4	.900	30.03	30.102	......	.89	.879	.90	30.006	.....	.85	.....	.847	.91	.965	.....	.83	.866	.95	30.024	....
5	.795	29.96	.058	......	.77	30.005	.99	.068	.....	30.01	30.03	.963	30.00	30.071	.....	.93	.929	.98	.066	....
6	.800	.80	29.913	......	.79	29.768	.79	29.826	.....	29.67	29.79	.775	29.90	29.980	.....	.77	.766	.83	29.906	....
7	.868	30.16	30.247	......	.86	30.050	30.14	30.232	.....	30.06	30.07	.995	30.15	30.229	.....	30.07	.996	30.15	30.236	....
8	30.088	.16	.233	......	30.08	.115	.13	.186	.....	.12	30.15	30.281	.14	.212	.....	.17	30.143	.14	.210	....
9	.096	.10	.182	......	.09	.120	29.97	.094	.....	.12	.12	.250	.03	.115	.....	.13	.132	.03	.130	....
10	29,981	.01	.058	......	.09	29.983	.95	29.986	.....	29.99	29.95	.070	.10	.213	.....	.03	.009	.02	.086	....
11	30.255	.22	.359	......	.25	30.158	30.00	30.160	.....	30.10	30.04	.035	29.97	.085	.....	.02	.122	.06	.201	....
12	30.000	29.79	29.923	......	29.97	29.799	29.66	29.691	.....	29.69	29.63	29.624	.58	29.532	.....	29.61	29.760	29.68	29.715	....
13	29.667	.79	.870	......	.65	.764	.81	.903	.....	.78	.79	.702	.89	.969	.....	.77	.732	.83	.914	....
14	.739	30.01	30.098	......	.73	.805	.99	30.066	.....	.78	.83	.848	30.09	30.190	.....	.84	.796	30.03	30.118	....
15	.913	.15	.269	......	.92	30.008	30.15	.216	.....	.99	30.03	30.073	.14	.214	.....	30.07	30.000	.15	.233	....
16	30.009	.20	.287	......	30.08	.068	.14	.231	.....	30.02	.04	.041	.03	.195	.....	.04	.043	.12	.237	....
17	29.978	29.96	.019	......	29.96	29.920	29.79	29.876	.....	29.84	29.90	29.885	29.79	29.883	.....	29.88	29.909	29.85	29.926	....
18	.907	.99	.063	......	.90	.931	.98	30.056	.....	.90	.92	.908	.98	30.107	.....	.90	.909	.98	30.075	....
19	.869	30.00	.117	......	.86	.883	30.14	.195	.....	.88	30.00	30.052	30.24	.374	.....	30.06	.943	30.13	.229	....
20	30.166	.31	.426	......	30.14	30.155	.19	.305	.....	30.09	.10	.060	.15	.234	.....	.03	30.106	.22	.322	....
21	29.701	29.81	29.884	......	29.69	29.573	29.65	29.532	.....	29.53	29.49	29.453	29.49	29.526	.....	29.42	29.551	29.65	29.647	....
22	.256	.45	.560	......	.21	.215	.40	.609	.....	.26	.37	.439	.70	.794	.....	.42	.310	.52	.654	....
23	.582	.71	.812	......	.54	.561	.61	.658	.....	.53	.52	.545	.64	.690	.....	.51	.541	.65	.720	....
24	.375	.76	.858	......	.37	.364	.81	.902	.....	.39	.46	.499	.86	.977	.....	.48	.419	.81	.912	....
25	.354	.73	.978	......	.30	.372	.81	.911	.....	.39	.53	.583	.86	.992	.....	.55	.440	.80	.927	....
26	.629	.93	30.090	......	.64	.779	.91	.989	.....	.75	.86	.884	.90	.956	.....	.88	.774	.91	30.012	....
27	.536	.61	29.657	......	.50	.414	.60	.564	.....	.40	.47	.502	.61	.658	.....	.47	.470	.61	29.626	....
28	.542	.72	.827	......	.51	.618	.81	.885	.....	.57	.64	.687	.91	30.044	.....	.66	.604	.81	.919	....
29	.792	30.08	30.249	......	.79	.869	30.05	.182	.....	.88	.93	.945	30.06	.170	.....	.92	.875	30.06	30.200	....
30	.935	.02	.100	......	.90	.861	29.93	29.962	.....	.83	.84	.842	29.89	29.962	.....	.84	.874	29.95	.008	....
31	.745	29.86	29.960	......	.72	.745	.89	.985	.....	.71	.74	.784	30.00	30.093	.....	.78	.746	.92	.013	....
																	29.801	29.94	29.995	

BAROMETER REDUCED TO THE LEVEL OF THE SEA, AT 32°.—APRIL, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7. A. M.	Gorham, 7 A. M.	Mt. Washington. 7:57 A. M.	Mt. Washington. 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M	Gorham, 2 P. M.	Mt. Washington 4:57 P. M.	Mt. Washington 7 P. M.	Mt. Washington 9 P. M.	Lunenburg, P. M.	Hanover, 9 P. M	Gorham, 9 P. M.	Mt. Washington. 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
	29.923	29.98	30.116	.....	29.89	29.861	29.92	29.960	.....	29.83	29.79	29.756	29.83	29.892	.....	29.71	29.820	29.91	29.989	....
	.561	.64	29.685	.....	.55	.581	.63	.608	.....	.56	.59	.644	.63	.681	.....	.62	.581	.63	.658	....
3	.703	.69	.796	....	.69	.747	.67	.727	.....	.70	.72	.728	.69	.741	.....	.70	.713	.68	.755	....
4	.654	.68	.758	......	.64	.706	.61	.711	.....	.66	.65	.568	.57	.619	.....	.56	.634	.61	.696	....
5	.367	.59	.707	....	.23	.302	.68	.774	.....	.40	.54	.650	.89	.984	.....	.64	.438	.72	.822	....
6	.736	.96	30.066	....	.80	.778	.92	30.005	.....	.76	.88	.914	.93	.996	.....	.88	.820	.94	30.022	....
7	.870	.79	29.894	......	.85	30.047	.75	29.753	.....	.93	.98	.963	.76	.815	.....	.93	.939	.77	29.821	....
8	.963	.79	.864	......	.94	.042	.78	.793	.....	30.05	30.08	30.071	.86	.869	.....	30.06	30.029	.81	.842	....
9	30.081	.87	.989	......	30.06	.039	.81	.866	.....	29.99	29.98	29.973	.80	.889	.....	29.95	.010	.83	.915	....
10	29.883	.82	.876	.....	29.84	29.877	.83	.840	.....	.85	.85	.868	.90	.963	....	.85	29.859	.85	.893	....
11	.880	.84	.876	......	.84	.781	.70	.739	.....	.69	.72	.727	.62	.640	.....	.68	.759	.69	.752	....
12	.632	.52	.583	.....	.55	.416	.56	.573	.....	.45	.48	.459	.61	.687	.....	.43	.488	.56	.614	....
13	.504	.61	.704	......	.49	.606	.60	.621	.....	.63	.67	.680	.66	.670	.....	·67	.606	.62	.665	....
14	.736	.67	.752	......	.67	.721	.66	.696	.....	.70	.72	.729	.67	.712	.....	.70	.711	.67	.720	....
15	.705	.69	.774	......	.69	.785	.73	.736	.....	.78	.82	.853	.78	.837	.....	.82	.779	.73	.782	....
16	.848	.86	.954	.....	.84	.890	.91	.909	.....	.89	.90	.894	.92	30.014	.....	.88	.877	.90	.959	....
17	.582	.93	30.031	......	.88	.968	.91	.991	....	.88	.93	.960	.97	.058	....	.93	.869	.94	30.026	....
18	.932	.99	.130	.....	.92	.967	30.02	30.054	.....	.91	.98	.996	30.07	.124	.....	.98	.955	30.03	.103	....
19	30.061	30.13	.200	......	30.04	30.131	.03	.094	.....	30.10	30.09	30.080	29.98	.069	.....	30.08	30.084	.05	.121	....
20	29.984	29.85	29.950	.....	29.91	29.865	29.75	29.743	....	29.74	29.70	29.742	.66	29.713	.....	29.72	29.800	29.75	29.802	....
21	.802	.72	.823	......	.77	.892	.68	.729	.....	.82	.88	.859	.76	.792	.....	.74	.823	.71	.781	....
22	.830	.76	.795	.....	.81	.822	.78	.771	.....	.77	.81	.835	.80	.842	.....	.80	.811	.78	.804	....
23	.815	.84	.946	......	.77	.792	.95	30.052	.....	.79	.....	.728	30.07	30.197	.....	.72	.769	.95	30.065	....
24	.935	30.19	30.315	......	.93	30.091	30.21	.283	.....	30.06	30.10	30.143	.22	.317	.....	30.11	30.052	30.21	.305	....
25	30.103	.14	.222	......	30.08	29.949	.01	29.956	.....	29.91	.....	29.831	29.94	29.964	.....	29.87	29.957	.03	.014	....
26	29.822	29.98	.105	......	29.81	30.021	.06	30.117	....	30.03	30.11	30.195	30.17	30.238	.....	30.18	30.024	.07	.153	....
27	30.256	30.24	.365	......	30.22	.181	.16	.293	.....	.19	.07	.132	.18	.242	....	.10	.164	.19	.300	....
28	29.966	.03	.108	......	.01	29.953	29.89	29.915	....	29.89	29.89	29.900	29.86	29.875	....	29.88	29.926	29.94	29.966	....
29	.849	29.72	29.806	......	29.82	.806	.69	.674	....	.82	.82	.832	.70	.729	....	.80	.830	.70	.736	....
30	.793	.66	.736	......	.83	.758	.68	.687	.....	.87	.72	.754	.71	.775	.....	.88	.801	.68	.733	....
																	29.830	29.83	29.890	

BAROMETER REDUCED TO THE LEVEL OF THE SEA, AT 32°.—MAY, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham, 2 P. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Lunenberg, 9 P. M.	Hanover, 9 P. M.	Gorham, 9 P. M.	Mt. Washington, 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	29.833	29.71	29.857	......	......	29.887	29.74	29.833	......	......	29.90	29.902	29.80	29.911	......	......	......	29.75	29.867	......
2	.975	.87	30.036	......	......	30.059	.89	30.028	......	......	30.06	30.063	.95	30.090	......	......	......	.90	30.051	......
3	30.093	.95	.081	......	......	.081	.99	.103	......	......	.12	.124	30.06	.186	......	......	......	30.00	.123	......
4	.138	30.11	.232	......	......	.129	30.05	.215	......	......	.05	.066	.06	.194	......	......	......	.07	.214	......
5	.012	29.87	.009	......	......	29.946	.80	29.884	......	......	29.95	29.903	29.72	29.808	......	......	......	29.80	29.900	......
6	29.885	.67	29.775	......	......	.825	.58	.667	......	......	.76	.724	.54	.594	......	......	......	.60	.679	......
7	.455	.40	.470	......	......	.330	.39	.473	......	......	.35	.380	.40	.551	......	......	......	.40	.498	......
8	.425	.42	.598	......	......	.421	.50	.666	......	......	.59	.299	.66	.839	......	......	......	.49	.701	......
9	.829	.81	.942	......	......	.899	.84	.925	......	......	.91	.929	.84	.962	......	......	......	.83	.943	......
10	.895	.82	.931	......	......	.843	.85	.873	......	......	.88	.907	.90	30.011	......	......	......	.86	.938	......
11	.935	.93	30.062	......	......	.896	.83	.943	......	......	.83	.868	.79	29.891	......	......	......	.85	.965	......
12	.918	.80	29.912	......	......	.946	.80	.794	......	......	30.01	.905	.71	.782	......	......	......	.77	.829	......
13	.831	.75	.833	......	......	.850	.75	.794	......	......	......	.666	.76	.889	......	......	......	.75	.839	......
14	.616	.71	.865	......	......	.551	.70	.812	......	......	......	.619	.70	.863	......	......	......	.70	.847	......
15	.696	.76	.872	......	......	.684	.75	.799	......	......	......	.763	.76	.892	......	......	......	.76	.854	......
16	.862	......	.931	......	......	.920	......	.822	......	......	......	.793	......	.638	......	......	......	......	.797	......
17	.545	......	.633	......	......	.652	......	.782	......	......	......	.788	......	.972	......	......	......	......	.796	......
18	.928	......	30.150	......	......	.992	......	30.701	......	......	......	30.066	......	30.156	......	......	......	......	30.135	......
19	30.203	......	.215	......	......	30.203	......	.090	......	......	......	.194	......	.085	......	......	......	......	.130	......
20	.221	......	.108	......	......	.273	......	.007	......	......	......	.290	......	.013	......	......	......	......	.043	......
21	.315	......	.050	......	......	.277	......	29.911	......	......	......	.227	......	29.906	......	......	......	......	29.956	......
22	.096	......	29.837	......	......	.001	......	.730	......	......	......	......	......	.879	......	......	......	......	.815	......
23	29.823	......	.865	......	......	29.790	......	.895	......	......	......	29.902	......	30.022	......	......	......	......	.927	......
24	.929	......	30.191	......	......	30.116	......	30.221	......	......	......	30.220	......	.298	......	......	......	......	30.237	......
25	30.297	......	.336	......	......	.282	......	.102	......	......	......	.140	......	29.962	......	......	......	......	.133	......
26	.019	......	29.954	......	......	.043	......	29.898	......	......	......	.003	......	.896	......	......	......	......	29.916	......
27	29.913	......	30.093	......	......	.120	......	30.145	......	......	......	.077	......	30.208	......	......	......	......	30.149	......
28	30.146	......	.134	......	......	.083	......	.141	......	......	......	.183	......	.051	......	......	......	......	.109	......
29	.242	......	.194	......	......	.696	......	29.972	......	......	......	.180	......	29.945	......	......	......	......	.037	......
30	.152	......	29.965	......	......	.192	......	.897	......	......	......	.285	......	.950	......	......	......	......	29.937	......
31	.146	......	.955	......	......	.191	......	.942	......	......	......	.493	......	30.068	......	......	......	......	.988	......
																		29.77	29.946	

BAROMETER REDUCED TO THE LEVEL OF THE SEA, AT 32°.—JUNE, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2. P. M.	Gorham, 2 P. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Lunenburg 9 P. M.	Hanover, 9 P. M.	Gorham, 9 P. M.	Mt. Washington, 10 P. M.	Mean of Mt. Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	30.132	.....	30.123	.....	.....	30.141	.....	30,058	.....	.....	.....	30.269	.....	30.063	.....	.....	30.181	.....	30.081	.....
2	.269	.....	.107	.....	.....	.312	.....	.012	.....	.....	.....	.309	.....	.007	.....	.....	.294	.....	.042	.....
3	.248	.....	.140	.....	.....	.278	.....	.928	.....	.....	.....	.229	.....	29.934	.....	.....	.252	.....	.001	.....
4	.144	.....	29.933	.....	.....	.147	.....	.844	.....	.....	.....	.111	.....	.857	.....	.....	.134	.....	29.878	.....
5	.119	.....	.974	.....	.....	.147	.....	.928	.....	.....	.....	.139	.....	.958	.....	.....	.135	.....	.953	.....
6	.181	.....	30.007	.....	.....	.167	.....	.853	.....	.....	.....	.190	.....	.845	.....	.....	.179	.....	.902	.....
7	29,882	.....	29.779	.....	.....	29.889	.....	.666	.....	.....	.....	29.861	.....	.708	.....	.....	29.877	.....	.784	.....
8	.976	.....	.772	.....	.....	30.014	.....	.762	.....	.....	.....	.815	.....	.848	.....	.....	29.935	.....	.794	.....
9	.952	.....	.986	.....	.....	.071	.....	30.028	.....	.....	.....	30.173	.....	30.114	.....	.....	30.065	.....	30.043	.....
10	30.262	.....	30.189	.....	.....	.209	.....	.033	.....	.....	.....	.157	.....	29.934	.....	.....	.314	.....	.052	.....
11	.002	.....	29.796	.....	.....	29.827	.....	29.566	.....	.....	.....	29.830	.....	.630	.....	.....	29.995	.....	29.664	.....
12	29.800	.....	.496	.....	.....	.725	.....	.490	.....	.....	.....	.673	.....	.534	.....	.....	.851	.....	.507	.....
13	.993	.....	.512	.....	.....	.633	.....	.435	.....	.....	.....	.613	.....	.600	.....	.....	.766	.....	.516	.....
14	.747	.....	.774	.....	.....	.832	.....	.807	.....	.....	.....	.972	.....	.865	.....	.....	.730	.....	.815	.....
15	30.000	.....	.928	.....	.....	30.010	.....	.893	.....	.....	.....	.998	.....	.952	.....	.....	.994	.....	.924	.....
16	29.950	.....	.996	.....	.....	.004	.....	.946	.....	.....	.....	30.028	.....	30.040	.....	.....	.984	.....	.994	.....
17	30.102	.....	30.148	.....	.....	.103	.....	30.074	.....	.....	.....	.188	.....	.076	.....	.....	30.077	.....	30.099	.....
18	.180	.....	.057	.....	.....	.132	.....	29.974	.....	.....	.....	.069	.....	29.936	.....	.....	.166	.....	29.989	.....
19	.037	.....	29.887	.....	.....	.062	.....	.850	.....	.....	.....	.074	.....	.863	.....	.....	.056	.....	.866	.....
20	.052	.....	.846	.....	.....	.030	.....	.748	.....	.....	.....	.032	.....	.811	.....	.....	.082	.....	.802	.....
21	29.950	.....	.958	.....	.....	29.906	.....	.991	.....	.....	.....	.049	.....	30.096	.....	.....	29.035	.....	30.015	.....
22	30.072	.....	30.152	.....	.....	30.066	.....	.992	.....	.....	.....	.092	.....	29.913	.....	.....	30.076	.....	.019	.....
23	29.914	.....	29.841	.....	.....	29.934	.....	.864	.....	.....	.....	.008	.....	.971	.....	.....	29.932	.....	29.892	.....
24	30.109	.....	30.019	.....	.....	30.076	.....	.978	.....	.....	.....	.127	.....	30.004	.....	.....	30.104	.....	30.000	.....
25	.202	.....	.138	.....	.....	.274	.....	30.076	.....	.....	.....	.210	.....	.056	.....	.....	.248	.....	.090	.....
26	.142	.....	.039	.....	.....	.130	.....	29.949	.....	.....	.....	.155	.....	29.984	.....	.....	.175	.....	29,991	.....
27	.161	.....	29.947	.....	.....	.108	.....	.792	.....	.....	.....	.062	.....	.730	.....	.....	.110	.....	.823	.....
28	29.936	.....	.669	.....	.....	29.830	.....	.596	.....	.....	.....	29.887	.....	.654	.....	.....	29.884	.....	.639	.....
29	.867	.....	.687	.....	.....	.888	.....	.730	.....	.....	.....	.902	.....	.907	.....	.....	.885	.....	.775	.....
30	.971	.....	30.043	.....	.....	30.106	.....	30.056	.....	.....	.....	30.204	.....	30.132	.....	.....	30.093	.....	30.077	.....
																	30.040		29.904	

THERMOGRAMS.—NOVEMBER, 1870.

Day of Month.	Mt. Washington, 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham. 2 P. M.	Mt. Washin.ton, 9 P. M.	Lunenburg, 9 P. M.	Hanover, 9 P. M.	Gorham, 9 P. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
13	19	35	33.0	..	18	42	45.7	..	21	38	42.5	....	...	...	...	19.3	38.0	40.6	...
14	15	36	33.6	..	17	50	42.6	..	20	33	32.4	....	...	...	...	17.3	41.0	36.6	...
15	18	30	32.3	32	20	36	36.3	38	15	30	31.9	....	...	...	...	17.6	32.0	33.5	34.0
16	15	20	22.0	24	14	30	36.7	30	14	27	29.4	....	...	. .	...	14.3	24.5	29.0	25.0
17	15	21	21.8	20	19	32	39.8	40	14	28	31.7	....	..	...	...	16.0	27.0	30.8	30.5
18	19	25	27 6	22	18	38	37.9	36	19	34	33.2	....	...	...	...	18.6	32.3	33.1	27.5
19	16	24	29.7	28	17	28	28.8	..	8	24	27.1	....	...	...	...	13.6	25.3	28.5	...
20	9	25	27.4	..	14	32	35.6	..	14	29	32.7	....	...	...	...	12.3	28.6	31.8	...
21	13	30	33.2	35	17	34	40.8	..	10	28	34.6	....	...	...	...	13.3	30.6	36.0	...
22	11	18	22.0	24	10	30	30.7	28	9	25	26.5	....	...	...	...	10.	21.0	26.5	26.0
23	24	36	35.0	30	22	38	39.8	39	19	32	36.9	....	...	...	...	21.6	25.3	37.2	29.5
24	9	34	30.4	29	7	32	33.0	32	6	27	32.6	....	...	...	...	7.3	31.0	32.0	35.5
25	20	26	25.1	30	27	35	41.5	46	27	29	30.3	....	...	...	...	24.6	30.0	32.2	38.0
26	28	28	30.7	32	24	39	40.0	44	22	38	38.7	....	...	...	...	24.6	29.0	36.2	38.0
27	24	40	36.0	..	24	44	48.0	..	19	38	42.9	....	...	...	...	22.3	40.6	42.0	...
28	15	35	31.8	38	17	42	45.0	44	21	32	33.4	....	...	...	...	17.6	36.0	36.8	41.0
29	26	32	36.4	30	23	35	34.0	30	15	34	31.1	....	...	...	...	21.3	33.5	34.5	30.0
30	0	24	25.1	.	5	27	30.5	30	9	28	27.1	....	...	...	...	4.6	26.0	27.5	...
																16.4	30.7	33.6	32.2

THERMOGRAMS.—DECEMBER, 1870.

Day of Month.	Mt. Washington, 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham, 2 P. M.	Mt. Washington, 9 P. M.	Lunenburg, 9 P. M.	Hanover, 9 P. M.	Gorham, 9 P. M.	Mt. Washington, 4:57 A. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	14	24	23.6	22	16	32	45.0	48	13.5	30	40.4	....	....	...	...	14.5	29	39.6	35
2	15	37	38.0	40	16	40	43.4	38	15	34	40.0	....	....	...	...	15.3	37	40.4	34
3	5	27	28.9	28	14	28	31.2	36	17	20	23.0	....	....	...	...	12.0	25	27.7	32
4	17	30	26.0	..	18	36	36.2	..	16	35	33.2	....	....	...	...	17.6	34	31.8	..
5	15	32	29.1	30	20	39	37.5	38	18	34	37.9	....	....	...	...	19.3	35	34.8	34
6	22	35	38.0	32	22	38	39.1	36	15	36	37.9	....	....	...	...	19.0	36	38.3	34
7	15	30	32.9	32	22	36	36.1	34	20	28	31.0	....	....	...	...	14.3	35	30.0	33
8	16	32	33.8	..	18	35	34.1	..	15	33	32.9	....	....	...	...	12.0	33	33.6	..
9	12	28	29.2	32	13	29	30.0	32	11	25	27.3	....	....	...	...	16.3	27	25.5	..
10	14	20	25.0	28	15	23	26.1	28	20	20	21.0	....	....	...	...	26.8	20	24.0	32
11	25	24	20.5	24	28.5	29	27.5	32	27	32	28.8	....	....	...	...	8.0	24	25.6	28
12	17	30	35.8	32	20	37	35.2	32	20	36	36.0	....	....	...	...	19.0	34	35.6	28
13	23	35	33.4	34	29	38	39.0	40	27	35	35.1	....	....	...	...	26.3	36	35.8	32
14	22	33	33.9	34	22.5	32	38.7	38	14	30	31.1	....	....	...	...	19.3	32	34.5	37
15	12	20	28.8	28	0	15	19.0	..	-7	13	16.0	....	...	...	5	2.6	16	21.2	..
16	-10	10	15.0	14	-6	19	23.0	22	-13	16	19.3	....	....	...	-5	-8.5	15	19.1	18
17	1	15	18.5	18	5	21	26.0	20	4	14	20.5	....	....	...	5	3.7	17	21.6	19
18	4	16	23.2	..	-1	18	23.1	..	-4	14	15.4	....	....	...	-2	-0.7	16	20.5	..
19	0	7	7.1	12	9.5	23	25.2	22	11	15	21.6	....	....	...	9	7.6	15	17.6	17
20	1.55	19	24.9	24	20	24	31.3	30	14	28	33.0	....	....	...	15	16.1	24	29.7	27
21	10	22	29.9	28	10	27	30.6	32	6	20	21.9	....	....	...	8	8.5	23	27.4	30
22	0	12	11.9	18	-1	18	19.2	22	-5	10	6.2	....	....	...	-9	-2.5	13	12.4	20
23	-4	3	4.0	10	-2	10	11.0	..	-2	-2	5.3	....	....	...	-1	-2.2	4	6.7	..
24	-10	5	2.1	..	-11	8	12.4	..	-15	-5	0.1	....	....	...	-16	-13.0	3	4.8	..
25	-14	18	8.6	..	-9	5	6.9	..	-7	0	1.0	....	....	...	-8	-9.5	8	5.5	..
26	-2	7	9.9	.	-1	18	23.0	..	0	17	21.5	....	....	...	-1	-1.0	14	18.1	..
27	0	16	16.0	..	5	25	25.0	..	7	20	18.5	....	....	...	6	4.5	20	19.8	..
28	6	20	17.9	..	9	30	27.0	..	11	18	21.0	....	....	...	11	9.2	23	21.9	..
29	6	10	13.6	..	3	10	8.9	..	1	0	5.0	....	....	...	1	2.7	7	9.2	..
30	1	15	6.5	..	8	10	10.9	..	5	18	16.0	....	....	...	5	4.7	4	11.2	..
31	15	24	24.9	..	14	29	32.2	..	14	28	30.6	....	....	...	6	14.0	27	29.2	..
																9.1	22.5	24.2	28.8

THERMOGRAMS.—JANUARY, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham, 2 P. M.	Mt. Washington, 9 P. M.	Lunenburg, 9 P. M.	Hanover, 9 P. M.	Mt. Washington. 7: 57 A. M.	Mt. Washington, 4: 57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	0	16	19.8	..	-7	20	22.6	..	-2	10	17.2	0	-7	6	-2	-1.7	15.3	19.8	.
2	10	4	8.5	18	9	26	32.3	28	7	25	28.6	10	10	10	8	9.1	18.3	22.4	23.0
3	-7	10	15.0	10	2	25	24.0	23	0	23	21.6	-7	-1	-5	0	-2.4	19.3	20.1	16.5
4	-18	-6	-2.1	..	-13	14	8.1	9	-14	-2	-.5	-18	-14	-13	-14	-14.9	2.0	1.8	4.5
5	-2	5	7.2	-2	10	29	23.8	15	18	28	30.2	-2	13	14	18	9.8	20.6	21.0	6.5
6	18	37	35.5	36	16	35	36.5	40	8	28	29.1	18	16	11	8	13.5	33.3	23.6	38.0
7	-6	8	16.9	14	-7	10	11.8	12	-8	-5	1.0	-6	-8	-10	-8	-7.4	4.3	10.0	13.0
8	-6	-18	-10.9	-15	-4	10	6.0	18	-5	3	5.8	-6	-5	-5	-5	-5.1	-1.6	.3	1.5
9	-6	-6	-1.7	-10	-3	12	6.1	14	-11	-7	-2.5	-6	-7	-10	-10	-7.4	-0.3	.8	2.0
10	-2	-22	-10.4	-12	0	5	6.0	18	4	-5	1.0	-2	1	2	4	1.0	-7.3	1.5	3.0
11	13	-6	-1.0	-1	23	20	14.5	22	25	17	19.9	13	26	25	28	21.9	10.3	11.2	10.5
12	31	22	23.2	27	33	31	32.2	38	33	32	33.0	31	33	33	34	32,5	28.3	29.6	32.5
13	34	32	33.3	30	36	42	42.0	..	38	36	34.1	34	36	33	33	34.9	36.6	36.4	...
14	32	34	25.6	..	34	45	40.2	..	34	38	36.0	32	34	34	34	38.0	39.6	33.9	...
15	29	35	36.2	32	28	36	33.1	..	32	37	34.3	29	28	..	32	29.6	36.0	34.5	...
16	32	38	35.0	36	33	38	37.7	..	31	35	30.8	32	33	33	31	32.1	37.0	34.5	...
17	1	18	19.9	22	8	35	28.9	..	-1	15	21.0	1	8	3	-1	2.5	22.6	23.2	...
18	-4	12	22.5	20	-5	19	19.5	20	0	4	-10.0	-4	-1	-3	0	-2.4	11.6	17.3	20.0
19	3	-8	2.3	-15	9	15	18.9	18	10	6	11.1	4	11	10	10	8.1	4.3	10.7	1.5
20	15	0	18.3	-3	17	24	28.5	28	15	21	26.8	15	15	14	15	15.1	15.0	24.5	12.5
21	13	20	26.1	22	15	31	34.6	34	7	27	30.1	14	12	..	8	11.5	26.0	30.2	28.0
22	-5	-2	13.0	..	-27	-8	-.1	..	-38	-18	10.0	-10	-32	..	-38	-25.	-9.3	.6	...
23	-35	-30	-18.0	-22	-4	-12	9.0	-5	1	-13	8.0	-35	-1	-1	0	-10.7	-18.3	11.6	-13.5
24	5	-12	-5.1	10	0	0	4.9	2	-8	3	5.0	0	-2	-4	-9	-2.5	-3.0	1.6	6.0
25	-18	0	5.2	2	-28	6	-1.5	10	-15	-22	-12.0	-18	-22	-15	-15	-18.7	-5.3	2.7	6.0
26	0	-20	-11.2	-15	5	5	5.5	4	6.5	-4	-4.0	0	15	5	16	6.7	-6.3	6.9	-5.5
27	5	-10	2.5	2	-4.5	18	18.8	26	-13	9	14.7	5	-5	-9	10	-1.3	5.6	12.0	14.0
28	-14	4	1.0	4	-5	15	11.4	20	3.5	2	6.6	-14	-2	-8	3	-5.2	7.0	6.3	12.0
29	3	5	10.3	0	7	24	19.0	18	8	15	18.3	3	5	..	8	4.9	14.6	15.8	9.0
30	7	24	20.9	29	13	33	32.6	36	11	38	29.4	7	13	13	11	9.2	31.6	27.6	32.5
31	23	28	29.9	32	20	45	37.1	37	34	42	33.8	24	32	34	34	28.7	38.3	30.2	34.5
																6.5	13.8	15.8	12.8

THERMOGRAMS — FEBRUARY, 1871.

Day of Month.	Mt. Washington. 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham, 2 P. M.	Mt. Washington, 9 P. M.	Lunenburg, 9 P. M.	Hanover, 9 P. M.	M,. Washington, 7 P. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	19	38	37.8	42	20	35	37.6	42	14	30	31.8	16	18	18	16	17.2	34.0	35.7	42.0
2	16	30	29.9	28	15	36	36.0	38	14	33	33.9	13	16	14	13	14.2	33.0	33.2	33.0
3	-19	5	7.8	6	-3	24	25.1	24	5	29	30.3	5	-19	-1	5	-3.9	20.0	17.7	15.0
4	-31	-8	1.1	-3	-34	-14	-2.4	-5	-40	-15	-10.2	-40	-31	-35	-40	-35.8	-12.0	-3.8	-4.0
5	-25	-28	-16.0	-18	-11	-10	-6.3	-8	-1	-20	-6.0	1	-25	-10	1	-10.0	-19.0	-9.4	-13.0
6	10	-12	-6.3	-8	13	7	5.0	12	15	2	5.5	11	10	9	15	11.7	-1.0	5.3	2.0
7	14	-5	-.9	-6	16	23	19.6	28	11	14	14.5	15	15	15	10	13.7	11.0	8.3	11.0
8	15	20	14.9	-26	14	28	28.3	29	18	24	25.9	17	15	17	20	16.5	24.0	26.0	1.5
9	18	29	25.8	28	20	35	35.8	40	18	34	34.6	1	18	21	17	16.1	33.0	32,0	34.0
10	0	24	24.3	26	-3	18	22.9	28	-9	10	15.7	-10	0	-6	-9	-5.2	18.0	20.9	27.0
11	-21	0	5.0	5	-13	12	16.1	15	-8	3	6.7	..	-21	-14	-8	-14.1	5.0	9.3	10.0
12	-2	5	0.0	10	14	10	11.8	28	9	10	12.0	5	-2	8	9	5.8	8.0	7.8	19.0
13	0	8	12.1	15	-5	15	19.5	26	4	7	9.0	3	0	5	4	1.7	10.0	13.5	20.5
14	7	0	-2.1	-6	14	20	11.5	28	8	18	14.9	8	7	13	8	9.2	13.0	11.2	11.0
15	0	12	5.8	20	13	26	23.0	33	20	18	20.3	17	0	14	20	12.0	19.0	19.6	26.5
16	14	18	20.9	22	17	26	35.0	31	9	28	30.8	13	14	15	9	13.0	24.0	28.9	25.5
17	4	20	20.4	24	12	28	34.4	40	14	25	26.9	13	4	13	14	10.5	24.0	27.2	32.0
18	13	24	29.0	30	27	36	39.4	38	17	25	35.0	..	13	26	17	18.9	28.0	34.4	34.0
19	-5	10	12.6	18	5	15	24.6	38	3	18	20.9	..	-5	5	3	1.0	14.0	22.7	28.5
20	3	20	18.5	12	4	25	34.0	38	2	18	26.1	..	3	3	2	2.8	21.0	26.2	25.0
21	2	20	9.4	6	-3	15	14.7	22	-8	0	6.0	-7	2	-10	-8	-4.5	12.0	10.0	19.0
22	4	-15	-6.0	-10	-2	10	14.8	26	3	-6	7.9	1	4	-1	3	1.7	-4.0	5.2	8.0
23	9	-5	-5.0	-5	19	20	22.3	35	25	24	24.8	23	9	19	25	17.0	13.0	17.7	15.0
24	35	38	28.9	16	35	45	38.7	38	33	45	40.2	33	35	33	33	33.9	43.0	35.6	27.0
25	22	38	40.4	43	19	40	44.3	48	13	30	36.9	..	22	17	13	17.6	36.0	40.5	45.5
26	7	28	28.6	40	21	38	39.3	46	25	35	35.3	23	7	24	25	17.5	34.0	34.5	43.0
27	26	34	33.3	42	15	30	37.8	40	6	24	29.1	9	27	12	6	11.5	29.0	33.4	41.0
28	-8	15	18.3	17	0	25	24.8	25	8	19	23.7	2	-8	1	10	.7	20.0	22.2	21.0
																6.8	17.6	19.9	21.4

THERMOGRAMS.—MARCH, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham, 2 P. M.	Mt. Washington, 9 P. M.	Lunenburg, 9 P. M.	Hanover, 9 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	15	32	29.3	....	16.0	38	40.8	....	11	36	34.9	15	16	15	11	14.1	35	34.6	....
2	13	32	30.0	....	17.0	35	37.0	....	24	34	39.6	22	13	8	25	16.5	34	35.5	....
3	33	33	35.9	....	37.5	45	46.2	....	19	35	37.3	32	34	35	18	29.7	34	39.4	....
4	18	25	28.1	....	20.0	38	35.4	....	15	30	33.2	..	18	18	15	17.3	31	32.2	....
5	11	24	26.3	....	17.5	38	39.4	....	14	31	33.0	16	11	16	14	14.7	31	32.9	....
6	18.5	34	31.2	....	20.0	37	36.9	....	17	35	35.2	16	19	18	18	16.9	35	34.4	....
7	7	20	24.6	....	16.5	32	33.4	....	18	25	27.5	16	7	15	18	13.9	26	28.5	....
8	24	30	29.3	...	31.5	45	45.7	....	31	36	39.9	30	24	30	32	...	34	38.3	....
9	33	38	37.2	....	40.0	50	45.8	....	34	45	48.0	36	34	37	35	18.9	44	32.7	....
10	36	53	52.5	....	35.0	51	48.3	....	24	40	39.7	25	31	33	24	35.5	48	46.5	....
11	25	34	32.3	....	29.5	58	56.9	....	30	46	47.8	32	24	28	30	29.7	46	45.6	....
12	35	40	46.0	....	35.0	53	56.2	....	33	42	53.1	33	34	35	32	28.3	45	51.7	....
13	15	38	34.9	....	18.0	43	45.9	....	14	34	35.3	13	17	15	14	33.9	48	38.7	....
14	10	28	31.1	...	10.0	35	41.3	....	7	42	33.1	8	7	10	6	16.5	35	35.1	....
15	5	35	27.1	....	18.5	38	41.5	....	19	33	36.3	19	6	18	19	8.2	35	34.9	....
16	25	33	33.2	....	34.0	38	35.8	....	24	36	33.8	34	28	35	34	14.9	36	34.2	....
17	38	35	34.0	....	43.0	43	44.7	....	39	40	42.2	39	39	41	39	30.5	39	40.3	....
18	20	37	37.5	....	24.0	48	45.9	....	19	33	34.7	19	20	24	19	39.7	39	39.3	....
19	19	32	30.5	....	12.0	36	41.9	....	14	32	30.0	..	19	12	15	20.7	33	34.1	....
20	21	28	29.8	....	17.5	39	42.4	....	24	38	32.8	28	22	30	25	13.0	35	35.0	....
21	25	34	33.4	....	32.0	35	35.6	....	20	35	33.6	26	25	33	19	23.9	35	34.2	....
22	11	30	30.9	....	12.0	36	36.7	...	9	31	32,3	9	12	11	9	25.7	32	33.3	....
23	14	28	30.1	...	22.0	30	33.1	....	22	30	31.8	25	14	21	22	10.4	29	31.7	....
24	2	21	24.4	....	-4.0	28	20.9	....	4	24	29.9	-2	2	-2	4	20.5	24	27.0	....
25	-1	20	27.9	....	4.0	30	34.4	....	6	27	31.5	5	-2	4	6	3.1	26	31.2	....
26	5	25	31.3	....	14.0	38	41.2	....	15	33	34.4	15	6	14	15	12.0	32	35.6	....
27	10	27	29.2	....	10.5	29	32.5	....	8	23	27.9	9	11	11	8	9.6	26	29.8	....
28	8	23	33.1	....	10.0	28	30.0	....	5	21	22.1	17	8	10	5	9.0	24	28.4	....
29	1	14	14.2	....	9.5	34	33.9	....	10	26	25.8	9	1	10	10	7.2	25	24.6	....
30	16	32	25.0	....	17.0	40	44.9	....	17.5	37	38.4	17	16	18	17	12.6	36	36.1	....
31	14	30	34.0	....	10.5	42	38.0	....	3	38	29.2	5	14	8	3	8.2	37	33.7	....
																17.8	34.5	35.2	

THERMOGRAMS.—APRIL, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham, 2 P. M.	Mt. Washington, 9 P. M.	Lunenburg, 9 P. M.	Hanover, 9 P. M.	Gorham, 9 P. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 10 P. M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	11.0	35	24.4	....	19.5	41	43.1	....	13.5	34	33.6	15	13	8	12	13.0	38.0	33.7	....
2	11.5	32	29.8	....	15.5	44	42.1	....	15.0	36	33.1	15	11	18	12	12.5	37.0	35.0	....
3	20.0	35	31.9	....	30.0	46	42.4	....	25.0	40	37.7	23	25	28	24	25.0	43.6	37.3	....
4	25.0	36	38.1	....	25.0	44	47.0	....	22.0	38	38.9	20	26	24	22	23.4	39.0	41.3	....
5	11.0	28	29.2	....	4.0	34	31.9	....	5.0	27	29.0	13	11	4	5	6.1	29.6	26.7	....
6	5.0	23	27.1	....	10.0	36	41.1	....	16.0	30	31.9	18	6	14	15	12.0	29.6	33.3	....
7	34.0	34	35.3	....	41.0	62	65.1	...	43.0	58	59.5	42	34	41	43	39.7	52.0	53.3	....
8	43.0	58	51.9	....	47.0	75	77.1	....	45.0	59	67.1	46	43	46	45	45.0	64.0	65.3	....
9	41.0	46	53.7	....	46.0	62	58.0	...	39.0	48	47.2	41	41	43	38	41.2	45.3	52.9	....
10	30.0	45	55.8	....	26.5	54	60.2	...	23.5	42	45.5	24	31	26	23	26.2	47.0	53.8	....
11	29.5	36	40.0	....	26.0	48	39.7	....	26.5	40	37.2	27	27	27	29	26.5	41.2	38.9	....
12	29.0	35	37.9	....	20.0	42	43.2	...	15.0	34	38.9	27	28	19	16	22.0	37.0	40.0	....
13	14.0	38	37.5	....	20.5	48	49.4	....	22.0	40	43.2	23	14	23	22	19.7	42.0	43.3	....
14	32.0	37	36.2	....	35.5	40	51.3	....	20.0	36	38.9	21	32	29	19	24.0	38.0	42.1	....
15	21.0	35	33.9	....	30.5	45	54.5	....	23.0	40	44.2	23	22	29	23	24.5	40.0	44.2	....
16	25.0	38	43.9	....	36.0	42	48.3	....	21.0	36	38.7	23	25	29	21	25.7	28.6	40.3	....
17	25.0	37	37.4	....	38.0	40	44.3	....	21.0	38	41.9	22	27	23	22	25.4	38.3	41.2	....
18	20.0	35	37.5	....	22.5	42	50.7	....	20.5	38	42.1	21	20	23	20	21.0	38.3	43.1	...
19	20.0	34	37.8	....	30.0	54	55.9	....	28.5	50	48.5	28	20	33	28	26.7	46.6	44.0	....
20	28.0	45	40.7	....	39.0	48	42.1	....	46.5	41	40.0	34	28	40	36	35.9	44.6	40.9	....
21	29.5	43	39.9	....	35.0	57	57.0	....	30.0	48	46.9	31	29	32	30	30.9	50.6	47.9	....
22	30.0	40	45.3	....	31.0	50	51.6	....	24.0	43	42.1	24	30	29	23	27.2	44.3	49.6	....
23	24.0	42	41.9	....	20.0	40	45.6	....	13.0	35	37.2	..	23	18	13	18.5	39.0	41.5	....
24	11.0	35	38.9	....	18.0	42	48.0	....	18.0	38	37.9	18	12	19	18	16.2	38.3	41.6	....
25	19.0	34	32.7	....	26.5	48	57.8	....	25.0	43	49.0	..	19	26	25	23.3	41.6	46.5	....
26	14.0	37	43.5	....	21.0	45	51.9	....	19.0	38	43.1	19	14	22	18	18.1	40.0	46.1	....
27	24.0	35	35.9	....	27.0	48	51.9	....	18.0	37	38.0	19	24	25	18	22.1	39.6	41.9	...
28	25.0	40	38.9	....	28.0	40	44.2	....	33.5	40	40.9	33	25	26	33	29.0	45.0	41.3	....
29	39.0	42	40.0	....	35.0	54	57.9	....	33.0	46	51.2	34	40	34	32	35.2	47.3	49.7	....
30	31.0	45	44.0	....	32.5	49	53.6	....	25.0	42	45.0	26	27	20	29	25.7	45.3	47.5	....
																24.7	40.7	43.5	

THERMOGRAMS.—MAY, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Lunenburg, 7 A. M.	Hanover, 7 A. M.	Gorham, 7 A. M.	Mt. Washington, 2 P. M.	Lunenburg, 2 P. M.	Hanover, 2 P. M.	Gorham. 2 P. M.	Mt. Washington, 9 P. M.	Lunenburg, 9 P. M.	Hanover, 9 P. M.	Gorham, 9 P. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 10 P M.	Mean of Mount Washington.	Mean of Lunenburg.	Mean of Hanover.	Mean of Gorham.
1	27	49	44.8	....	29.5	52	59.3	....	27.5	46	52.0	....	....	...	...	28.2	49	52.0	...
2	26	48	51.2	....	29.5	50	59.1	....	27.5	45	48.7	....	....	...	...	27.2	48	53.0	...
3	28	42	46.1	....	32.5	52	47.8	....	24.0	43	42.7	....	....	...	...	27.1	46	45.5	...
4	21	44	37.3	....	22.5	42	38.7	....	21.0	38	35.7	....	....	...	...	21.6	41	37.2	...
5	23	39	35.4	....	35.0	44	41.9	....	38.0	37	39.2	....	....	...	...	33.5	40	38.8	...
6	42	42	50.0	....	45.0	49	59.0	....	36.0	48	50.1	....	....	...	...	39.5	46	36.3	...
7	25	42	42.5	....	24.0	48	49.9	....	19.5	42	42.8	....	....	...	...	22.3	44	45.0	...
8	15	36	41.6	....	18.5	42	47.2	....	20.5	38	41.9	....	....	...	...	18.2	39	43.5	...
9	20	42	45.8	....	24.0	48	51.9	....	22.0	40	42.5	....	....	...	...	22.2	43	46.7	...
10	23	43	42.5	....	24.0	50	52.0	....	21.0	40	41.5	....	....	...	...	22.5	44	45.3	...
11	20	43	50.1	....	27.0	54	56.9	....	27.0	45	51.9	....	....	...	...	25.0	47	52.9	...
12	27	50	56.9	....	36.0	58	69.8	....	31.0	52	55.7	....	....	...	...	32.0	53	60.8	...
13	29	..	....	....	27.0	..	....	....	14.0	..	....	....	....	...	...	23.3	..	...	...
14	11.5	..	....	....	17.0	..	....	....	21.0	..	....	....	....	...	...	16.5	..	...	...
15	15	..	....	....	20.5	..	....	....	21.0	..	....	....	....	...	...	18.8	..	...	...
16	22	..	....	....	41.0	..	....	....	38.0	..	....	....	....	...	...	33.6	..	...	...
17	30	..	....	....	27.5	..	....	....	21.5	..	....	....	....	...	...	26.3	..	...	...
18	20	..	....	....	26.0	..	....	....	25.0	..	....	....	....	...	...	23.6	..	...	...
19	27	..	....	....	38.0	..	....	....	36.5	..	....	....	....	...	...	33.5	..	...	...
20	41	..	....	....	51.5	..	....	....	49.5	..	....	....	....	...	...	47.3	..	...	...
21	51	..	....	....	63.0	..	....	....	52.5	..	....	....	....	...	...	55.5	..	...	...
22	50.5	..	....	....	48.0	..	....	....	38.0	..	....	....	....	...	...	48.1	..	...	...
23	31.5	..	....	....	24.0	..	....	....	25.0	..	....	....	....	...	...	33.5	..	...	...
24	16.5	..	....	....	27.0	..	....	....	25.0	..	....	....	....	...	...	22.8	..	...	...
25	37.5	..	....	....	54.0	..	....	....	50.0	..	....	....	....	...	...	47.1	..	...	...
26	47	..	....	....	45.0	..	....	....	43.0	..	....	....	....	...	...	45.1	..	...	...
27	27	..	....	....	31.0	..	....	....	29.0	..	....	....	....	...	...	29.0	..	...	...
28	32	..	....	....	35.5	..	....	....	41.0	..	....	....	....	...	...	36.1	..	...	...
29	47	..	....	....	46.0	..	....	....	44.5	..	....	....	....	...	...	45.5	..	...	...
30	56	..	....	....	55.5	..	....	....	52.0	..	....	....	....	...	...	54.1	..	...	...
31	50	..	....	....	51.0	..	....	....	41.0	..	....	....	....	...	...	47.3	..	...	...
																32.4	45	46.4	...

DIRECTION AND FORCE OF WINDS.—NOVEMBER, 1870.

Day of Month.	Mt. Washington, 7 A. M.		Lunenburg, 7 A. M.		Hanover, 7 A. M.		Gorham, 7 A. M.		Mt. Washington, 7 : 57 A. M.		Mt. Washington, 2 P. M.		Lunenburg, 2 P. M.		Hanover, 2 P. M.		Gorham, 2 P. M.		M. Washington, 4 : 57 P. M.		Mt. Washington, 9 P. M.		Lunenburg, 9 P. M.		Hanover, 9 P. M.		Gorham, 9 P. M.	
	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.
13	N. W.	24	S. W.	2	. . .	0	. . .	.	....	..	N. W.	26	W.	2	W.	25	. . .	.	....	..	N. W.	22	S. W.	2	N. W.	12	. . .	..
14	W.	13	S. W.	2	S. W.	2	. . .	.	....	..	S. W.	42	S. W.	2	. . .	0	. . .	.	....	..	S. W.	41	S. W.	2	. . .	0	. . .	..
15	W.	5	N. W.	2	. . .	0	W.	2	....	..	W.	2	S. W.	2	N.	4	W.	2	....	..	W.	1	N. W.	2	. . .	0	W.	..
16	W.	14	N. E.	2	. . .	0	S. W.	.	....	..	W.	15	S. W.	2	S.	2	W.	2	....	..	W.	28	W.	2	. . .	0	. . .	..
17	W.	16	N. E.	2	. . .	0	W.	.	....	..	W.	14	N. W.	2	S.	4	N. E.	4	....	..	W.	2	W.	2	S.	4	. . .	..
18	W.	4	E.	2	. . .	0	W.	.	....	..	S. W.	6	N. E.	2	S. W.	2	E.	4	....	..	S. W.	5	S. E.	2	. . .	0	. . .	..
19	W.	7	S.	2	N. W.	4	N. W.	.	....	..	N. W.	11	W.	2	W.	4	. . .	.	....	..	N. W.	14	S. W.	2	N. W.	2	. . .	..
20	W.	16	W.	2	W.	2	. . .	.	....	..	W.	18	S. W.	2	. . .	0	. . .	.	....	..	N.W.	2	S. W.	2	. . .	0	. . .	..
21	W.	12	W.	2	E.	2	W.	.	....	..	W.	15	S. W.	2	W.	2	. . .	.	....	..	S. W.	46	S. W.	4	S. W.	4	. . .	..
22	S.	1	S. W.	2	. . .	0	W.	.	....	..	S.	3	N. E.	4	S. E.	4	N. E.	4	....	..	S.	35	N.	2	. . .	0	N. E.	3
23	S.	27	N. E.	25	W.	2	N. E.	2	....	..	S. W.	26	S. W.	4	S. W.	4	S. W.	.	....	..	S. W.	36	S. W.	2	N.	12	. . .	..
24	W.	78	S. W.	2	N. E.	12	N. W.	4	....	..	N. W.	76	S. W.	2	W.	4	N. W.	12	....	..	N. W.	68	W.	2	N.	2	. . .	..
25	N. W.	25	W.	2	. . .	12	N. W.	2	....	..	N. W.	14	S. W.	2	S.	4	W.	.	....	..	N. W.	12	N. W.	2	. . .	0	. . .	..
26	W.	4	S. E.	2	. . .	0	S. W.	2	....	..	N. W.	16	S. W.	2	W.	4	N. W.	12	....	..	N. W.	26	S. W.	2	. . .	0	. . .	.
27	N. W.	47	S. W.	2	S. E.	25	. . .	.	....	..	N. W.	46	S. W.	4	W.	12	. . .	.	....	..	N. W.	14	N. W.	12	. . .	0	. . .	..
28	N. W.	15	N. W.	2	. . .	0	W.	2	....	..	N. W.	17	N. W.	2	N. E.	4	W.	2	....	..	N. W.	14	W.	2	N. E.	2	. . .	..
29	W.	5	N. E.	2	S. E.	12	N. E.	2	....	..	W.	4	N. E.	2	N. E.	4	E.	4	....	..	W.	17	N. W.	2	N.	12	. . .	..
30	N. W.	17	N. W.	2	N.	25	W.	.	....	..	N. W.	24	S. W.	2	N.	4	W.	4	....	..	N. W.	47	N. W.	2	S.	2	. . .	..

DIRECTION AND FORCE OF WINDS.—DECEMBER, 1870.

Day of Month.	Mt. Wsahington, 7 A. M.		Lunenburg, 7 A. M.		Hanover, 7 A. M.		Gorham, 7 A. M.		Mt. Washington, 7:57 A. M.		Mt. Washington, 2 P. M.		Lunenburg, 2 P. M.		Hanover, 2 P. M.		Gorham, 2 P. M.		Mt. Washington, 9 P. M.		Lunenburg, 9 P. M.		Hanover, 9 P. M.		Gorham, 9 P. M.	
	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.
1	W.	78	N. W.	1	S. W.	2	S. E.	2	....	..	W.	70	S. W.	1	S.	2	S. W.	3	W.	65	N. W.	1	S.	1	....	..
2	N. W.	46	N. E.	1	S.	1	W.	..	....	..	W.	67	S. E.	1	W.	1	W.	3	W.	48	S. E.	1	W.	3	....	..
3	N. W.	76	N. W.	1	N.	4	N. W.	3	....	..	N. W.	47	N. W.	1	N. W.	1	W.	3	N. W.	35	N. W.	1	. . .	0	....	..
4	N. W.	37	S. W.	1	. . .	0	. . . .	..	....	..	N. W.	34	N. W.	1	. . .	0	. . . .	..	N. W.	31	W.	1	. . .	0	....	..
5	W.	4	N. W.	1	. . .	0	W.	..	....	..	S. W.	4	S. W.	1	E.	1	S. E.	1	S.	38	N. E.	2	S. E.	4	....	..
6	S.	4	N. E.	1	. . .	0	N. E.	1	....	..	N. W.	7	N. E.	1	. . .	0	S. W.	0.5	N. W.	80	N.	1	N. W.	2	....	..
7	N. N. W.	75	W.	1	N. E.	2	N. W.	3	....	..	N. W.	12	N. W.	1	. . .	0	W.	2	S.	16	S. W.	1	. . .	0	....	..
8	S.	24	N. E.	1	. . .	0	. . . .	..	....	..	S. E.	5	N. E.	1	. . .	0	. . . .	..	N. N. W.	45	S. E.	1	. . .	0	....	..
9	N.	67	N.	1	N. W.	3	W.	1	....	..	N. W.	49	N. W.	1	N. W.	2	W.	2	N. N. W.	33	N. W.	2	. . .	0	....	..
10	N. W.	64	N. E.	2	N. W.	2	W.	4	....	..	N. W.	51	N. W.	2	N.	2	W.	2	N. W.	15	N. W.	1	N.	2	....	..
11	E.	35	S. E.	1	. . .	0	W.	2	....	..	S. E.	27	E.	1	. . .	0	W.	..	S. S. E.	21	N. E.	1	. . .	0	....	..
12	N. N. W.	24	N. E.	1	S. E.	1	S. E.	2	....	..	E.	36	N. E.	1	E.	2	N. E.	3	S. S. E.	67	N. E.	1	N.	1	....	..
13	S.	23	N. E.	1	N.	1	E.	2	....	..	W.	14	N. E.	1	. . .	0	W.	..	N. W.	14	N. W.	1	. . .	0	....	..
14	N. W.	6	S. W.	1	. . .	0	W.	1	....	..	N. W.	52	N. W.	1	W.	2	N. W.	1	N. W.	63	W.	2	W.	2	....	..
15	W.	60	W.	3	N. W.	3	W.	2	....	..	W.	65	W.	4	N. W.	3	. . . .	..	W.	90	W.	3	N. W.	3	....	..
16	N. W.	84	N. W.	5	N. W.	3	W.	3	....	..	N. W.	65	N. W.	4	W.	2	N. W.	2	N. W.	74	N. W.	1	N. W.	4	....	..
17	N. W.	48	N. W.	2	N. W.	2	N. W.	4	....	..	N. W.	34	S. W.	1	N. W.	1	N. W.	3	N. W.	26	S. W.	1	S.	1	....	..
18	S. W.	50	W.	3	W.	4	. . . .	..	....	..	N. W.	47	W.	2	N.	2	. . . .	..	N. W.	65	N. W.	4	N.	2	....	..
19	N.	62	N. W.	1	. . .	0	N. W.	1	....	..	N. W.	36	S. W.	1	N. W.	2	W.	3	S.	4	S. W.	1	. . .	0	....	..
20	S.	35	S.	1	S. E.	1	N. E.	3	....	..	S. W.	54	W.	1	S. W.	1	W.	3	W.	42	S. E.	1	S. W.	2	....	..
21	S. W.	45	N. W.	1	S. W.	3	W.	1	....	..	N. W.	63	N. W.	3	S. W.	3	N. W.	2	N. W.	66	N. W.	4	. . .	0	....	..
22	W.	63	S. W.	2	. . .	0	N. W.	1	....	..	S. W.	45	N. W.	2	S. W.	2	W.	2	N. W.	44	W.	1	N.	1	....	..
23	N.	2	W.	1	N. E.	2	S. W.	1	....	..	N.	3	N. W.	2	N. E.	2	. . . .	..	N.	6	N. W.	1	. . .	0	....	..
24	N.	78	W.	1	N. E.	2	. . . .	..	....	..	N.	60	N. W.	2	N.	3	. . . .	..	N.	63	W.	1	N.	3	....	..
25	N.	46	N. W.	1	N.	1	. . . .	..	....	..	N.	61	S. W.	1	. . .	0	. . . .	..	W.	13	N. W.	1	N.	1	....	..
26	S.	47	N. W.	1	S. W.	1	. . . .	..	....	..	S. W.	10	S. W.	2	S.	3	. . . .	..	S. W.	78	S. W.	1	W.	3	....	..
27	S. W.	45	S. W.	1	S.	3	. . . .	..	....	..	S. W.	43	S. W.	1	S.	3	. . . .	..	S. W.	25	S. W.	3	. . .	0	....	..
28	W.	40	N. E.	1	. . .	0	. . . .	..	....	..	N. W.	39	S. W.	1	. . .	0	. . . .	..	Calm.	..	W.	1	N.	1	....	..
29	N.	45	N. W.	3	N. W.	2	. . . .	..	....	..	N.	74	N.	2	N. W.	3	. . . .	..	N.	44	W.	1	W.	2	....	..
30	Calm.	..	E.	1	. . .	0	. . . .	..	....	..	N. W.	12	N. E.	1	. . .	0	. . . .	..	S. S. W.	66	N. E.	2	S. E.	4	....	..
31	S.	25	W.	1	. . .	0	. . . .	..	....	..	S.	15	S. W.	1	S.	1	. . . .	..	W.	60	S. W.	1	. . .	0	....	..

DIRECTION AND FORCE OF WINDS.—JANUARY, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenburg, 7 A. M.		Hanover, 7 A. M.		Gorham, 7 A. M.		Mt. Washington, 7:57 A. M.		Mt. Washington, 2 P. M.		Lunenburg, 2 P. M.		Hanover, 2 P. M.		Gorham, 2 P. M.		Mt. Washington, 4:57 P. M.		M. Washington, 9 P. M.		Lunenburg, 9 P. M.		Hanover, 9 P. M.		Mt. Washington, 10 P. M.	
	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.
1	N.	67	N. W.	2	N. W.	4	. . .	..	N.	61	N.	60	N. W.	4	N. W.	2	. . .	..	N.	56	N.	56	W.	2	N. E.	12	N.	55
2	S.	34	S. E.	2	. . .	0	N. E.	4	S.	24	S, W.	60	N. W.	2	S.	12	S. W.	2	S. W.	71	S. W.	78	W.	25	W.	12	S. W.	76
3	N.	79	W.	12	S. E.	4	W.	25	N.	78	S. W.	35	N. W.	4	S.	12	E.	4	W.	37	S. W.	4	N. W.	12	S. W.	2	S. W.	24
4	N. W.	24	W.	2	N.	2	W.	1	N. W.	27	W.	63	N. W.	4	. . . .	0	W.	2	W.	56	W.	46	N. W.	2	. . . .	0	W.	42
5	S. S. W.	46	S. W.	2	. . .	0	E.	2	S.	46	S.	37	S. W.	2	S. W.	12	E.	4	S.	32	S.	62	N. W.	2	S. W.	12	S.	65
6	W.	25	S. W.	2	. . .	0	E.	1	W.	29	W.	37	S. W.	4	W.	4	S. W.	2	W.	61	W. S. W.	64	S. W.	4	S. W.	12	S. W.	68
7	N. W.	69	W.	2	N. W.	12	W.	12	N. W.	60	W.	48	W.	2	N.	4	W.	12	N.	42	W. N. W.	32	N. W.	2	. . .	0	N. W.	35
8	Calm.	..	N. W.	2	. . .	0	E.	4	Calm.	..	S. W.	4	N. W.	2	. . . .	0	N. W.	4	S. W.	5	N. W.	2	N. E.	2	. . .	0	N. W.	2
9	N.	27	N. E.	2	N. E.	2	W.	4	N.	23	N.	36	N. W.	2	N. W.	12	W.	4	N.	12	N.	35	N. E.	2	N.	2	N.	27
10	W.	38	N. W.	2	. . .	0	W.	12	W.	38	W.	30	S. E.	2	. . . .	0	W.	4	W.	39	N. W.	11	N. E.	2	. . .	0	N. W.	10
11	W.	22	N.	2	. . .	0	N. W.	1	W.	22	S. W.	48	N. E.	2	. . . .	0	N. E.	2	S. W.	52	S. W.	45	N. E.	2	. . .	0	S. W.	45
12	S. W.	34	N. E.	2	N.	2	W.	4	S. W.	54	S. W.	50	S. E.	2	. .	0	W.	2	S. W.	48	S. W.	35	N. E.	2	. . . .	0	S. W.	35
13	W.	12	N. E.	2	. . .	0	W.	4	S. W.	33	S. W.	25	S. W.	2	. . . .	0	. . .	..	W.	17	W. N. W.	26	N. W.	2	N. N. E.	2	W.	29
14	N. W.	40	N. E.	2	. . .	0	. . .	..	N. W.	40	W. N. W.	12	S. E.	2	. . . .	0	. . .	..	S.	4	W. N. W.	12	S. E.	2	. . . .	0	N. W.	12
15	S. S. E.	38	S. E.	4	E. S. E.	4	N. E.	25	S.	38	E. S. E.	52	N. E.	2	S. S. E.	12	. . .	..	S. W.	58	S. S. W.	58	N. E.	4	S. E.	25	S. W.	58
16	S. S. W.	42	N. E.	2	S. W.	2	N. E.	4	S.	42	S. W.	25	N. E.	2	. . . .	0	. . .	..	S. W.	24	S. W.	5	N. W.	2	N. W.	12	S. W.	4
17	N. N. W.	75	N. W.	12	N.	12	W.	35	N. W.	78	N. W.	68	N. W.	4	N. N. E.	12	W.	12	N.	68	N. N. W.	65	W.	2	. . .	0	N. W.	65
18	N. W.	33	N. W.	2	N. N. W.	4	W.	4	N. W.	40	N. W.	32	N. W.	2	N. N. W.	4	W.	4	N. W.	23	N. W.	19	N. W.	2	N.	4	N. W.	19
19	W.	8	N. E.	2	. .	0	W.	2	W.	8	W.	17	N. E.	2	W. S. W.	2	W.	2	W.	8	S. S. W.	20	W.	2	S.	4	S. W.	22
20	W.	34	N. W.	2	. .	0	N. W.	4	W.	34	W.	29	S. E.	2	S. S. W.	4	E.	12	W.	47	W.	36	S. E.	2	. . . .	0	W.	36
21	W.	14	S. W.	2	. . .	0	N. W.	2	W.	14	N. W.	22	S. E.	2	. . . .	0	W.	2	N. W.	22	W. N. W.	27	S. E.	2	. . . .	0	W.	7
22	N. W.	64	N. W.	4	N. W.	25	. . .	..	N. W.	65	N.	72	N. W	25	N.	25	. . .	..	N. W.	81	N. W.	88	N. W.	12	N.	4	N. W.	78
23	N. W.	65	N. W.	12	N. N. E.	12	W.	35	N. W.	67	N. W.	36	N. W.	2	N. E.	4	E.	4	N.	8	N. N. E.	1	W·	2	N. E.	2	. . . .	..
24	S. W.	17	S. E.	2	N. E.	2	E.	4	S. W.	17	S. W.	36	N. E.	2	. . . .	0	W	4	S. W.	37	W.	29	N.	2	. . . .	0	W.	32
25	S. S. W.	55	N. W.	4	N. E.	4	W.	25	S. W.	55	N. W.	69	N. W.	12	N. W.	45	W.	4	N. W.	71	N. N. W.	52	N. W.	2	N. N. W.	4	N. W.	50
26	N.	16	N. E.	2	N. E.	4	N. W.	2	N.	6	S. W.	12	N. E.	4	N. E.	2	N. E.	4	S.	18	S.	28	N. E.	2	. . . .	0	S.	32
27	W. N. W.	29	S. W.	2	. . .	0	N. E.	2	W.	28	W.	46	S. ·W.	2	. . .	0	N. W.	4	W.	46	W. N. W.	40	N. W.	25	. . .	0	N. W.	42
28	N. W.	60	N. W.	2	. . .	0	W.	4	N. W.	60	N. W.	36	N. W.	2	N. E.	2	W.	2	N. W.	24	S. W.	14.5	N.	2	N.	2	S. W.	14
29	S.	25	N. E.	2	. . .	0	N. E.	12	S.	23	S. S. W.	34	N. E.	2	S. W.	2	N. E.	52	S. S. W.	28	W. S. W.	44	N. E.	2	. . .	0	W.	52
30	N. W.	51	N. W.	2	. . .	0	W.	4	N. W.	54	N. W.	14	S. W.	2	N. E.	2	W.	4	W.	8	S. S. W.	25	S. W.	2	N. W.	2	S. W.	25
31	W. S. W.	25	S. E.	2	S. S. W.	12	E.	12	S. W.	42	S. W.	70	S. W.	4	S. W.	12	E.	2	S. W.	75	W. S. W.	54	S. W.	4	S. W.	12	S. W.	44

DIRECTION AND FORCE OF WINDS.—FEBRUARY, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenburg, 7 A. M.		Hanover, 7 A. M.		Gorham, 7 A. M.		Mt. Washington, 2 P. M.		Lunenburg, 2 P. M.		Hanover, 2 P. M.		Gorham, 2 P. M.		Mt. Washington, 9 P. M.		Lunenburg, 9 P. M.		Hanover, 9 P. M.	
	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.
1	W.	55	S. W.	25	N. N. W.	12	W.	12	W.	10	S. W.	2	N.	12	W.	2	W. S. W.	9	W.	2	N. N. E.	2
2	W.	16	S. E.	2	S.	2	W.	2	W.	27	S. W.	4	S.	25	N. E..	4	N. W.	60	W.	75	W.	35
3	N. W.	70	N. W.	12	. . . .	0	W.	4	N. W.	62	N. W.	4	S. W.	12	W.	4	W. S. W.	48	N. W.	25	S. W.	12
4	N. W.	69	W.	45	N. W.	45	N. W.	35	N. W.	64	W.	35	N. W.	45	N. W.	25	N. W.	65	W.	12	N.	25
5	N. W.	84	W.	4	N. W.	12	N. W.	35	N. W.	88	N. W.	4	N.	35	N. W.	35	W. N. W.	40	N. W.	2	N. N. E.	25
6	W. N. W.	50	N. E.	2	N. N. W.	4	W.	4	N. W.	36	N. W.	2	N. E.	4	W.	2	N.	28	W.	2	N.	12
7	W. N. W.	12	N. W.	2	. .	0	W.	2	W. N. W.	8	N. W.	2	. . .	0	W.	2	W. S. W.	1	S. W.	2	. . . .	0
8	S. W.	19	N. E.	2	. . .	0	N. E.	4	S. S. W.	44	S. E.	2	S. E.	2	N. E.	4	S. S. W.	28	S. E.	2	. . .	0
9	S. S. E.	15	N. E.	2	. . .	0	S. E.	4	S. W.	18	N. E.	2	S. E.	4	N. E.	4	W.	36	N. E.	4	N. E.	2
10	N. W.	52	W.	25	W.	25	W.	12	N. W.	88	W.	35	W.	25	W.	35	N. W.	88	W.	45	W.	4
11	N. W.	64	N. W.	12	N.	2	W.	35	N. W.	58	N. W.	4	N. N. W.	4	W.	12	N. W.	51	N. W.	2	N.	2
12	W.	24	S. E.	2	N. N. E.	2	W.	4	W.	6	N. E.	2	N. N. E.	2	N. E.	12	Calm.	..	N. E.	2	N. E.	2
13	W.	21	N.	2	. . .	0	W.	4	N.	14	N. W.	2	N. W.	12	W.	4	Calm.	..	W.	2	. . . . .	0
14	S. W.	5	N.	2	S. E.	2	W.	2	S. S. W.	4	N. E.	2	N, E.	4	W.	4	N. W.	17	N. E.	2	. . . . .	0
15	W.	33	N. W.	4	. . .	0	W.	4	S. W.	24	S. W.	2	N. N. W.	4	W.	2	S. W.	14	W.	2	. . . . .	0
16	W.	34	S. E.	2	. . . .	0	E.	2	S. W.	46	S.	2	. .	0	N. E.	2	N. N. W.	53	W.	12	N. N. W.	12
17	N. W.	51	W.	2	N. W.	4	W.	2	N. W.	24	W.	2	. . . .	0	W.	2	S. S. W.	19	S. W.	2	. . .	0
18	S. S. W.	62	E.	2	S. S. E.	25	N. E.	25	S. S. W.	66	S.	4	. . . .	0	N. E.	35	W.	62	W.	35	N. W.	12
19	N. W.	43	W.	12	. . . .	0	W.	4	W.	28	W.	2	. . . .	0	N. E.	2	W.	37	W.	4	. . . . .	0
20	N. W.	41	S. W.	2	S. S. W.	2	W.	4	W.	33	W.	2	W. S. W.	2	W.	4	W.	39	W.	2	N. N. W.	2
21	N. W.	31	W.	2	N. E.	2	W.	2	N.	12	W.	4	N. W.	12	W.	2	N.	27	W.	4	N. W.	4
22	N.	11	W.	2	. . .	0	W.	2	N.	27	W.	2	E. S. E.	2	W.	2	N. W.	34	W.	2	. . . . .	0
23	W.	47	W.	2	. . . .	0	W.	4	S. W.	38	W.	2	S. S. W.	2	N. E.	4	S. W.	22	W.	2	S.	4
24	S. W.	59	S.	4	S.	2	S. E.	2	W. S. W.	42	S. W.	4	. . .	0	S. E.	2	S. S. W.	56	W.	2	. . . . .	0
25	W.	53	S. W.	12	W.	12	S. E.	25	S. W.	75	W.	4	W.	4	W.	35	N. W.	72	W.	2	N. N. W.	4
26	S. W.	28	N. W.	2	. . .	0	W.	2	W. S. W.	10	S. W.	2	. . . .	0	S. W.	2	S. S. W.	65	S. W.	2	S. E.	12
27	S. W.	52	S. W.	2	S.	2	S. E.	4	W. S. W.	80	N. W.	4	W.	25	N. W.	25	N. W.	92	N. W.	12	N. N. W.	4
28	N. N. W.	69	N. W.	25	N. W.	12	W.	12	N. W.	62	N. W.	2	N.	4	N. W.	25	S. S. W.	17	N. W.	2	S. W.	4

DIRECTION AND FORCE OF WINDS DURING THE MONTH OF MARCH, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenburg, 7 A. M.		Hanover, 7 A. M.		Mt. Washington, 2 P. M.		Lunenburg, 2 P. M.		Hanover, 2 P. M.		Mt. Washington, 4:57 P. M.		Lunenburg, 9 P. M.		Hanover, 9 P. M.	
	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.
1	S. S W.	42	S. W.	4	S. S. W.	12	S. W.	42	S. W.	12	W.	25	W.	64	W.	25	W.	12
2	N. W.	44	S. W.	2	. . .	0	W.	28	W.	2	S. E.	12	S. S. W.	62	N. E.	2	S.	4
3	S. S. W.	66	N. E.	2	S. E.	2	S. S. W.	89	W.	2	S.	12	W.	82	N. W.	2	N. W.	25
4	. . .	..	N.	2	N.	12	W. S. W.	2	S. W.	2	N. W.	2	. . .	0	N. W.	2	N. N. E.	4
5	N. W.	58	N.	2	. . .	0	W.	42	S. W.	2	. . .	0	W.	8	N. W.	2	. . .	0
6	S. S. W.	42	N. W.	2	. . .	0	S. S. W.	14	N. W.	2	. . .	0	N. W.	56	N. W.	2	N. W.	12
7	N. W.	42	N. W.	2	N.	4	. . .	0	N. W.	2	N.	2	W.	12	N. W.	2	. . .	0
8	S. S. W.	18	N. E.	2	S. S. W.	2	S. S. W.	10	S. W.	2	S.	12	W. S. W.	11	W.	2	S.	2
9	S. W.	48	N. W.	2	S. E.	4	S. W.	45	N. W.	2	S. S. W.	2	S. W.	54	N. W.	2	. . .	0
10	S. W.	45	S. W.	2	S.	4	S. W.	56	S. W.	2	S. W.	4	N. W.	42	S. W.	2	. . .	0
11	S. W.	29	N. W.	2	. . .	0	S. S. W.	50	S. W.	4	S. S. E.	12	S.	60	S. W.	2	S. S. E.	12
12	S. W.	36	N.	2	. . .	0	S. S. W.	28	S. W.	4	S. E.	25	S. S. W.	62	S. W.	25	S. S. W.	35
13	N. W.	35	N. W.	2	N.	2	N. W.	42	N. W.	4	W.	4	N. W.	24	W.	2	N.	2
14	N. W.	32	N. W.	2	. . .	0	N. W.	52	N. W.	12	N. W.	12	N. W.	45	N. W.	2	N.	4
15	N. W.	35	N. W.	2	. . .	0	S. W.	12	S. W.	2	. . .	0	N. W.	9	S. W.	2	. . .	0
16	S. W.	7	N. E.	2	S.	2	S. W.	16	S. E.	2	S. S. E.	12	S. W.	38	S. E.	2	S. S. E.	25
17	S. W.	46	W.	2	S. E.	12	S. S. W.	25	S. W.	2	S. W.	4	S. W.	27	S. W.	4	. . .	0
18	N. W.	24	N. W.	2	N. W.	2	S. W.	28	N. W.	2	W. N. W.	4	W. N. W.	54	W.	2	N. W.	2
19	W.	34	S. W.	2	S.	4	W. N. W.	48	N. W.	4	W. N. W.	12	N. N. W.	32	N. W.	2	N.	4
20	W. S. W.	22	N. E.	2	S.	1	W.	10	N. E.	2	S. E.	25	S. S. W.	57	S. E.	2	S. E.	35
21	S. S. E.	68	S. E.	2	S. E.	4	S. S. E.	42	N. E.	2	. . .	0	W.	19	N. E.	2	W.	12
22	W. N. W.	65	N. W.	12	W.	12	W. S. W.	87	N. W.	25	W.	12	N. W.	66	N. W.	35	W.	12
23	W.	61	N. W.	12	. . .	0	S. W.	36	S. W.	2	N.	4	W. S. W.	24	S. W.	2	. . .	0
24	W.	72	S. W.	4	N. W.	4	N. W.	76	N. W.	4	N. W.	25	N. W.	64	S. W.	2	N. W.	4
25	N. W.	88	N. W.	25	N. W.	4	W. N. W.	86	N. W.	45	N. W.	25	N.	67	N. W.	12	N. W.	25
26	N.	52	N. W.	4	N. W.	4	N.	27	N. W.	2	N.	12	. . .	0	W.	2	. . .	0
27	S. E.	48	N. E.	2	E. N. E.	4	S. E.	37	N. E.	2	. . .	0	N. E.	16	N. W.	2	. . .	0
28	N.	27	N. W.	2	N. N. W.	12	W. S. W.	29	N. W.	2	N. W.	25	W. N. W.	48	N. W.	2	. . .	0
29	N. W.	81	N. W.	2	. . .	0	W.	46	N. W.	2	. . .	0	W.	56	W.	2	. . .	0
30	W. N. W.	29	N. W.	2	. . .	0	W.	39	N. W.	2	. . .	0	N. W.	24	N.	2	. . .	0
31	N. W.	49	N.	2	. . .	0	W.	43	N. W.	2	N. W.	12	N. N. W.	48	W.	2	N.	4

DIRECTION AND INTENSITY OF WINDS.—APRIL, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenburg, 7 A. M.		Hanover, 7 A. M.		Mt. Washington, 7:57 A. M.		Mt. Washington, 2 P. M.		Lunenburg, 2 P. M.		Hanover, 2 P. M.		Mt. Washington, 4:57 A. M.		Mt. Washington, 9 P. M.		Lunenburg, 9 P. M.		Hanover, 9 P. M.	
	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.
1	W.	2	S. W.	2	. .	0	....	..	S.	4	S.	2	S. E.	12	....	..	S.	22	S. W.	2	S. E.	4
2	S. E.	32	N.	2	. . .	0	....	..	N. E.	11	N. W.	2	N. W.	4	....	..	N.	22	N.	2	. . .	0
3	W.	11	N.	2	. . .	0	....	..	S. W.	2	N. W.	4	S. S. W.	2	....	..	S. W.	18	N. W.	2	S.	2
4	S. S. W.	27	S. W.	2	. . .	0	....	..	. . .	0	S. W.	2	. . .	0	....	..	W.	33	S. W.	2	S.	2
5	W. S. W.	89	N. W.	25	N. W.	35	....	.	S. W.	52	N. W.	12	N. W.	35	....	..	W.	43	N. W.	2	N.	12
6	N. N. W.	53	N.	2	N. N. E.	4	....	..	N. W.	50	N. W.	2	N. W.	4	....	..	W.	27	N. W.	2	. . .	0
7	S. W.	48	N. W.	2	S.	2	....	..	W.	38	N.	2	S. S. W.	12	....	..	W.	46	N. W.	2	. . .	0
8	W.	50	N. W.	2	. . .	0	....	..	W.	23	N. E.	2	W.	4	....	..	W.	34	N. E.	2	. . .	0
9	S. W.	24	N.	2	. . .	0	....	..	S. W.	18	N.	2	S. E.	25	....	..	W.	42	N. W.	2	. . .	0
10	N. W.	42	N. W.	4	W.	12	....	..	N. N. W.	48	N. W.	2	N.	4	....	.	N. N. W.	52	W.	2	N.	12
11	S. S. W.	15	N. E.	2	S. E.	25	....	..	S. S. W.	28	S. E.	2	S. E.	25	....	..	S.	20	E.	2	S. E.	12
12	W.	12	S. E.	2	S.	4	....	..	W.	54	N. W.	4	W.	12	....	..	N. W.	60	N. W.	2	W.	4
13	N. W.	46	N. W.	2	. .	0	....	..	W. N. W.	18	N. W.	2	. . .	0	....	..	W. S. W.	3	N.	4	S.	2
14	W.	2	N.	2	. . .	0	....	..	W.	2	N. W.	2	S. W.	2	....	..	W.	4	W.	2	. . .	0
15	N.	1	N.	2	. . .	0	....	..	W.	5	N.	2	W.	4	....	..	W. S. W.	12	N. W.	2	. . .	0
16	W.	1	W.	2	N. E.	2	....	..	S. W.	1	N. E.	2	N. N. W.	2	....	..	. . .	0	N. E.	2	N. W.	4
17	W. S. W.	4	N.	2	N. E.	2	....	..	N. W.	2	N. W.	2	N.	12	....	..	N. W.	26	N. W.	2	N. W.	12
18	N. W.	42	N.	2	. . .	0	....	..	N. W.	16	N.	2	N. W.	25	....	..	N. W.	25	N. W.	2	. . .	0
19	N. N. W.	24	N. W.	2	N. E.	4	....	..	W. S. W.	6	N. W.	2	S. W.	25	....	..	W. N. W.	1	W.	2	S.	12
20	W. S. W.	28	S. E.	2	S. E.	25	....	..	S. W.	58	S. E.	2	S. E.	12	....	..	S. W.	62	S. E.	2	. . .	0
21	W.	49	S. W.	2	. .	0	....	..	W. N. W.	15	S. W.	2	W.	2	....	..	W.	20	S. W.	2	. . .	0
22	W.	1	N. E.	2	. . .	0	....	..	W.	17	S. E.	2	N. W.	4	....	..	N. W.	18	E.	2	. . .	0
23	W.	49	N. W.	4	N. W.	2	....	..	N. W.	62	N. W.	4	W. N. W.	35	....	..	N. W.	74	N. W.	25	N.	12
24	N. W.	62	N. W.	2	N. W.	12	....	..	N. W.	24	N. W.	2	N. W.	25	....	..	W. N. W.	23	W.	2	. . .	0
25	W. S. W.	17	W.	2	. . . .	0	....	..	S. W.	23	S. W.	2	S. W.	2	....	..	N. W.	32	W.	2	N. N. W.	4
26	N. W.	51	N. W.	2	N. N. W.	12	....	..	W. N. W.	17	N. W.	2	N. N. W.	4	....	..	N.	1	N.	2	. . .	0
27	E.	1	N. E.	2	. . .	0	...	..	S. E.	9	S. E.	2	S. E.	12	....	..	S. E.	39	S. E.	2	S. E.	35
28	S. S. E.	16	S. E.	2	S. E.	12	....	..	S.	9	S. W.	2	S. E.	35	....	..	S. S. W.	2	S. E.	2	S. E.	4
29	W.	1	N. E.	2	. . .	0	....	..	W.	5	N.	2	W.	2	....	..	W. N. W.	8	N. W.	2	. . .	0
30	W.	11	N. E.	2	. . .	0	....	..	W.	15	N. E.	2	N. E.	2	....	..	W.	30	N.	2	. . .	0

DIRECTION AND INTENSITY OF WINDS.—MAY, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenburg, 7 A. M.		Hanover, 7 A. M.		Mt. Washington, 7;57 A. M.		Mt. Washington, 2 P. M.		Lunenburg, 2 P. M.		Hanover, 2 P. M.		Mt. Washington, 4:57 P. M.		Mt. Washington, 9 P. M.		Lunenburg, 9 P. M.		Hanover, 9 P. M.		Gorham, 9 P. M.	
	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.
1	N. W.	12	N. W.	2	N.	2	....	..	N. N. W.	21	N.	2	W.	4	....	..	W. N. W.	28	W.	2	N. N. W.	4	....	..
2	W.	15	N. W.	2	. . . .	0	....	..	W.	9	N.	2	N. N. W.	4	....	..	W. N. W.	20	N.	2	. . .	0	....	..
3	W. S. W.	7	N. E.	2	N.N.E.	2	....	..	N. W.	6	N. E.	2	S. E.	4	....	..	E.	8	N. E.	2	S. E.	2	....	..
4	S. E.	15	S. E.	2	N. W.	2	....	..	E. S. E.	38	S. E.	2	. . .	0	....	..	S. E.	56	E.	2	S. E.	2	....	..
5	S.	28	E.	2	. . .	0	....	..	S. W.	22	N. E.	2	. . .	0	....	..	W. S. W.	3	N. E.	2	S. W.	2	....	..
6	N. W.	3	N. E.	2	. . .	0	....	..	N. W.	1	N. E.	2	E.	4	....	..	W. S. W.	1	N.	2	N. N. W.	4	....	..
7	S. W.	57	N. W.	2	N. W.	2	....	..	W.	63	N. W.	4	N. W.	35	....	..	N. W.	54	N.	12	W.	12	....	..
8	N. N. W.	58	S. W.	25	W.	12	....	..	W.	62	S. W.	12	W. N. W.	12	....	..	W.	32	N. W.	4	N. W.	2	....	..
9	N. N. W.	35	N. W.	2	N. W.	4	....	..	N. N. W.	14	N. W.	4	N.	12	....	..	N. N. W.	10	W.	2	. .	0	....	..
10	W.	8	N. W.	2	S. [illegible]	2	....	..	N. W.	20	N.	2	N. W.	25	....	..	N. W.	25	N. W.	2	. . .	0	....	..
11	N. W.	17	N. W.	2	S.	4	....	..	W. S. W.	55	N. W.	2	S.	12	....	..	W. N. W.	46	W.	2	S. W.	12	....	..
12	W.	18	S. E.	2	S. W.	12	....	..	W.	30	N. E.	2	W. N. W.	12	....	..	W.	35	N.	2	. . .	0	....	..
13	W.	16	N. E.	2	N. E.	12	....	..	W.	39	N. W.	4	N. W.	25	....	..	W.	28	N. W.	2	N. W.	4	....	..
14	W. S. W.	48	N. W.	25	N. W.	25	....	..	W.	54	N. W.	35	N. W.	25	....	..	W.	43	N. W.	2	N. W.	2	....	..
15	W.	43	N.	2	W.	2	....	..	W. N. W.	37	N. W.	12	W.	12	....	..	S. W.	37	W.	2	.	0	....	..
16	W.	34	....		. . .	0	....	..	S. W.	27	....	..	S.	35	....	..	S. S. W.	53	....	..	S.	35	....	..
17	W.	69	....	..	N. W.	4	....	..	W.	47	....	..	N.	35	....	..	W. S. W.	41	....	..	N. W.	25	....	..
18	W. N. W.	41	....	..	N. W.	25	....	..	W. S. W.	45	....	..	N. W.	25	....	..	W.	46	....	..	. . .	0	....	..
19	S. S. W.	12	....	..	S.	2	....	..	S. W.	10	....	..	S.	12	....	..	W.	9	....	..	. . .	0	....	..
20	S. W.	39	....	..	S.	4	....	..	W.	12	....	..	S. W.	25	....	..	S. W.	19	....	..	. . .	0	....	..
21	S. W.	3	....	..	S.	2	....	..	S.	4	....	..	S. E.	12	....	..	S. W.	12	....	..	S. W.	4	....	..
22	S. W.	7	....	..	S. W.	4	....	..	S. W.	15	....	..	. . .	25	....	..	W. S. W.	35	....	..	. . .	0	....	..
23	W.	59	....	..	N. W.	4	....	..	W.	51	....	..	N. W.	25	....	..	N. N. W.	32	....	..	. . .	0	....	..
24	W. N. W.	53	....	..	N. W.	25	....	..	W.	44	....	..	N. W.	25	....	..	W.	24	....	..	. . .	0	....	..
25	W.	25	....	..	S. W.	2	....	..	W.	19	....	..	S. S. W.	25	....	..	W.	29	....	.	S. W.	25	....	..
26	S. W.	65	....	..	. . .	0	....	..	W. S. W.	48	....	..	W.	12	....	..	S. W.	62	....	..	. . .	0	....	..
27	W.	58	....	..	N.	25	....	..	N. W.	25	....	..	N.	0	....	..	W.	3	....	..	N.	2	....	..
28	S. W.	16	....	..	. . .	0	....	..	S. W.	25	....	..	S.	4	....	..	N. W.	25	....	.	. .	0	....	.
29	S. W.	16	....	..	. . .	0	....	..	S. W.	17	....	..	N. W.	12	....	..	W.	25	....	..	S.	4	....	..
30	N. W.	45	....	..	S.	4	....	..	N. W.	25	....	..	W.	12	....	..	N. W.	22	....	..	. . .	0	....	..
31	N. W.	16	....	..	. . .	0	....	..	W.	10	....	..	. . .	..	....	..	N. N. W.	14	....	..	. . .	.	....	..

DIRECTION AND FORCE OF WINDS.—JUNE, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenburg, 7 A. M.		Hanover, 7 A. M.		Gorham. 7 A. M.		Mt. Washington, 2 P. M.		Lunenburg. 2 P. M.		Hanover. 2 P. M.		Gorham, 2 P. M.		Mt. Washington. 9 P. M.		Hanover, 9 P. M.	
	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.
1	....	0	....	..	S. E.	4	....	..	W.	12	....	..	S.	2	....	..	S. W.	20	....	..
2	S. S. W.	18	....	..	S. W.	12	....	..	S. W.	18	....	..	S.	4	....	..	N. W.	26	....	..
3	W.	8	....	..	S.	4	....	..	S. W.	6	....	..	....	0	....	..	N. W.	16	N. E.	4
4	N. N. W.	12	....	..	....	..	....	..	W.	14	....	..	N. E.	2	....	..	N. N. W.	38	S.	2
5	S. S. W.	18	....	..	N. W.	4	....	..	S. S. W.	12	....	..	N.N.W.	4	....	..	W.	16	....	..
6	....	0	....	..	N. E.	4	....	..	W.	3	....	..	S.	12	....	..	N. W.	28	S.	25
7	N. W.	40	....	..	S.	12	....	..	S. W.	20	....	..	S.	12	....	..	N. W.	30	....	..
8	W.	14	....	..	W.	4	....	..	S. W.	18	....	..	W.	12	....	..	N. W.	85	S. W.	4
9	N. W.	44	....	..	N. W.	12	....	..	N. W.	26	....	..	N. W.	25	....	..	....	0	....	..
10	....	0	....	..	N. E.	2	....	..	S. W.	6	....	..	S.	12	....	..	N. W.	9	....	..
11	W.	15	....	..	S.	4	....	..	S. W.	24	....	..	S.	35	....	..	N. W.	46	....	..
12	N. W.	72	....	..	S. W.	2	....	..	N.	3	....	..	S. E.	2	....	..	N. W.	28	....	..
13	N. W.	13	....	..	S. W.	12	....	..	S. W.	38	....	..	S. W.	4	....	..	N. W.	68	W.	25
14	N. W.	18	....	..	S. W.	12	....	..	S. W.	28	....	..	W.	12	....	..	N. N. W.	10	....	..
15	N. W.	2	....	..	N. E.	2	....	..	N. W.	12	....	..	S. W.	4	....	..	N. W.	4	....	..
16	W.	14	....	..	S.	2	....	..	N. W.	14	....	..	S. W.	2	....	..	N. N. W.	16	N. W.	4
17	N. N. W.	12	....	..	S.	4	....	..	N. W.	7	....	..	N. W.	4	....	..	....	0	S.	2
18	S. W.	18	....	..	....	..	....	..	S. S. W.	23	....	..	S. E.	4	....	..	S. W.	28	....	..
19	S.	4	....	..	....	..	....	..	S. S. W.	1	....	..	W.	4	....	..	N. W.	28	....	..
20	N. W.	18	....	..	S.	2	....	..	N. W.	18	....	..	W.	12	....	..	N. W.	29	N. W.	4
21	N. W.	46	....	..	....	..	....	..	N. W.	67	....	..	N. W.	45	....	..	N. W.	18	N. W.	4
22	N. W.	26	....	..	S.	2	....	..	N. W.	12	....	..	W.	12	....	..	N. W.	26	S.	12
23	N. W.	16	....	..	S. E.	2	....	..	N. W.	44	....	..	N.	2	....	..	W.	36	N.	4
24	W.	2	....	..	S. W.	2	....	..	W.	5	....	..	S. W.	12	....	..	N. W.	8	....	..
25	W.	8	....	..	....	..	....	..	N. W.	6	....	..	S.	12	....	..	W.	26	S.	2
26	N. W.	28	....	..	S.	4	....	..	N. W.	25	....	..	W.	12	....	..	N. W.	28	....	..
27	S. W.	11	....	..	....	..	....	..	N. W.	16	....	..	S. W.	12	....	..	N. W.	12	S.	12
28	S. W.	11	....	..	S. W.	4	....	..	W.	15	....	..	W.	12	....	..	N. W.	27	S.	2
29	W.	17	....	..	N.	2	....	..	N. W.	17	....	..	N. W.	25	....	..	N. W.	41	....	..
30	W.	19	....	..	S.	4	....	..	W.	21	....	..	N. W.	12	....	..	N. W.	12	....	..

AMOUNT AND KIND OF CLOUDS.—NOVEMBER, 1870.

Day of Month.	Mt. Washington, 7 A. M.		Lunenb'g 7 A. M.	Hanover, 7. A. M.		Gorham, 7 A. M.		Mt. Washington, 2 P. M.		Lunenb'g 2 P. M.	Hanover, 2 P. M.		Gorham, 2 P. M.		Mt. Washington, 9 P. M.		Lunenb'g 9 P. M.	Hanover, 9 P. M.	
	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.
13	9 below.		10	5	Cu. cir. st.			Clouds	on mt.	5	8	Cir. cum.			Clouds	on mt.	10	10	Nim. St.
14	8 below.			7	Cir. st.			8 below.	St.	10	6	Cir. st.			Clouds	on mt.	10	10	St.
15	Light	clouds.	10	10	St.	10	Nim.	8 below.		7	10	Cum. st.	10	Nim.	4 below.	St.	10	1	St.
16	1 below.	St.						2 below.	St.		1	Cir. cum.			3 below.	St.			
17	2 below.	St.				1	Nim.	6 below.	St.		2	Cir. cum.	3	Nim.	4 below.	Cir.			
18	5 below.	St.	8			5	Hazy.	Clouds	on mt.	10	10	St.	9	Nim.	Clouds	on mt.	10	10	St.
19	2 ab. 3 bel.	St.	10	10	St.	5	Hazy.	Clouds	on mt.	10	10	St.			Clouds	on mt.	10	10	St.
20	Light	clouds.		6	Cu. cir.			1 below.	St.	10	10	St.			10 above.		10	10	St.
21	Light	clouds.	4	10	Cir. st.	5	Nim.	7 ab. 1 bel.	St. cir. st	10	10	St.			Clouds	on mt.	5	5	Cu. st.
22	Light	clouds.				4	Nim.	9 above.	Cir. St.	8	10	St.	10	Nim.	Clouds	on mt.	10	10	Nim.
23	5 above.	Cir. St.		10	St.	10	Nim.	Clouds	on mt.	10	10	St.	6	Nim.	Clouds	on mt.	10	10	St.
24	Cloudy	on mt.	5	10	St.	9	Nim.	Clouds	on mt.	10	10	St.	10	Nim.	Clouds	on mt.	10	5	St.
25	Cloudy	on mt.		10				8 above.	St.						10 above.	St.			
26	1 above.	St.	10		Nim.	5		Clouds	on mt.	10	8	Cir.	8	Nim.	Clouds	on mt.	10	10	Nim.
27	10 above.	St.		10	Nim.			Clouds	on mt.						Clouds	on mt.		1	Cir.
28	Clouds	on mt.		10		9	Nim.	4 above.	St.				4	Cir.	9 above.	St.		9	Nim.
29	Clouds	on mt.	10		St.	10	Nim.	Clouds	on mt.	10		Haze.	10	Nim.	Clouds	on mt.	5	2	Cu.
30	Clouds	on mt.		10		7	Nim.	Light	clouds.						Clouds	on mt.			

DIRECTION AND FORCE OF WINDS.—JUNE, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenburg, 7 A. M.		Hanover, 7 A. M.		Gorham. 7 A. M.		Mt. Washington, 2 P. M.		Lunenburg. 2 P. M.		Hanover. 2 P. M.		Gorham, 2 P. M.		Mt. Washington. 9 P.M.		Hanover, 9 P. M.	
	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.	D.	F.
1	....	0	....	..	S. E.	4	....	..	W.	12	....	..	S.	2	....	..	S. W.	20	....	..
2	S. S. W.	18	....	..	S. W.	12	....	..	S. W.	18	....	.	S.	4	....	..	N. W.	26	....	..
3	W.	8	....	..	S.	4	....	..	S. W.	6	....	..	....	0	....	..	N. W.	16	N. E.	4
4	N. N. W.	12	....	..	....	..	....	..	W.	14	....	..	N. E.	2	....	..	N. N. W.	38	S.	2
5	S. S. W.	18	....	..	N. W.	4	....	..	S. S. W.	12	....	..	N.N.W.	4	....	..	W.	16	....	..
6	....	0	....	..	N. E.	4	....	..	W.	3	....	..	S.	12	....	..	N. W.	28	S.	25
7	N. W.	40	....	..	S.	12	....	..	S. W.	20	....	..	S.	12	....	..	N. W.	30	....	..
8	W.	14	....	..	W.	4	....	..	S. W.	18	....	..	W.	12	....	..	N. W.	85	S. W.	4
9	N. W.	44	....	..	N. W.	12	....	..	N. W.	26	....	..	N. W.	25	....	..	....	0	....	..
10	....	0	....	..	N. E.	2	....	..	S. W.	6	....	..	S.	12	....	..	N. W.	9	....	..
11	W.	15	....	..	S.	4	....	..	S. W.	24	....	..	S.	35	....	..	N. W.	46	....	..
12	N. W.	72	....	..	S. W.	2	....	..	N.	3	....	..	S. E.	2	....	..	N. W.	28	....	.
13	N. W.	13	....	..	S. W.	12	....	..	S. W.	38	....	.	S. W.	4	....	..	N. W.	68	W.	25
14	N. W.	18	....	..	S. W.	12	....	..	S. W.	28	....	..	W.	12	....	..	N. N. W.	10	....	..
15	N. W.	2	....	..	N. E.	2	....	..	N. W.	12	....	..	S. W.	4	....	..	N. W.	4	....	..
16	W.	14	....	..	S.	2	....	..	N. W.	14	....	..	S. W.	2	....	..	N. N. W.	16	N. W.	4
17	N. N. W.	12	....	..	S.	4	....	..	N. W.	7	....	..	N. W.	4	....	..	....	0	S.	2
18	S. W.	18	....	..	....	..	....	..	S. S. W.	23	....	..	S. E.	4	....	..	S. W.	28	...	..
19	S.	4	....	..	....	..	....	..	S. S. W.	1	....	..	W.	4	....	..	N. W.	28	....	..
20	N. W.	18	....	..	S.	2	....	..	N. W.	18	....	..	W.	12	....	..	N. W.	29	N. W.	4
21	N. W.	46	....	..	....	..	....	..	N. W.	67	...	..	N. W.	45	....	..	N. W.	18	N. W.	4
22	N. W.	26	....	..	S.	2	....	..	N. W.	12	....	..	W.	12	....	..	N. W.	26	S.	12
23	N. W.	16	....	..	S. E.	2	....	..	N. W.	44	....	..	N.	2	....	..	W.	36	N.	4
24	W.	2	....	..	S. W.	2	....	..	W.	5	....	..	S. W.	12	....	..	N. W.	8	....	..
25	W.	8	....	..	....	..	....	..	N. W.	6	....	..	S.	12	....	..	W.	26	S.	2
26	N. W.	28	....	..	S.	4	....	..	N. W.	25	....	..	W.	12	....	..	N. W.	28	....	..
27	S. W.	11	....	..	....	..	....	..	N. W.	16	...	.	S. W.	12	....	..	N. W.	12	S.	12
28	S. W.	11	....	..	S. W.	4	....	..	W.	15	....	..	W.	12	....	..	N. W.	27	S.	2
29	W.	17	....	..	N.	2	....	..	N. W.	17	....	..	N. W.	25	....	..	N. W.	41	....	..
30	W.	19	...	..	S.	4	...	..	W.	21	....	..	N. W.	12	....	..	N. W.	12	....	.

AMOUNT AND KIND OF CLOUDS.—NOVEMBER, 1870.

Day of Month.	Mt. Washington, 7 A. M.		Lunenb'g 7 A. M.	Hanover, 7. A. M.		Gorham, 7 A. M.		Mt. Washington, 2 P. M.		Lunenb'g 2 P. M.	Hanover, 2 P. M.		Gorham, 2 P. M.		Mt. Washington, 9 P. M.		Lunenb'g 9 P. M.	Hanover, 9 P. M.	
	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.
13	9 below.		10	5	Cu. cir. st.			Clouds	on mt.	5	8	Cir. cum.			Clouds	on mt.	10	10	Nim. St.
14	8 below.			7	Cir. st.			8 below.	St.	10	6	Cir. st.			Clouds	on mt.	10	10	St.
15	Light	clouds.	10	10	St.	10	Nim.	8 below.		7	10	Cum. st.	10	Nim.	4 below.	St.	10	1	St.
16	1 below.	St.						2 below.	St.		1	Cir. cum.			3 below.	St.			
17	2 below.	St.				1	Nim.	6 below.	St.		2	Cir. cum.	3	Nim.	4 below.	Cir.			
18	5 below.	St.	8			5	Hazy.	Clouds	on mt.	10	10	St.	9	Nim.	Clouds	on mt.	10	10	St.
19	2 ab. 3 bel.	St.	10	10	St.	5	Hazy.	Clouds	on mt.	10	10	St.			Clouds	on mt.	10	10	St.
20	Light	clouds.		6	Cu. cir.			1 below.	St.	10	10	St.			10 above.		10	10	St.
21	Light	clouds.	4	10	Cir. st.	5	Nim.	7 ab. 1 bel.	St. cir. st	10	10	St.			Clouds	on mt.	5	5	Cu. st.
22	Light	clouds.				4	Nim.	9 above.	Cir. St.	8	10	St.	10	Nim.	Clouds	on mt.	10	10	Nim.
23	5 above.	Cir. St.		10	St.	10	Nim.	Clouds	on mt.	10	10	St.	6	Nim.	Clouds	on mt.	10	10	St.
24	Cloudy	on mt.	5	10	St.	9	Nim.	Clouds	on mt.	10	10	St.	10	Nim.	Clouds	on mt.	10	5	St.
25	Cloudy	on mt.		10				8 above.	St.						10 above.	St.			
26	1 above.	St.	10		Nim.	5		Clouds	on mt.	10	8	Cir.	8	Nim.	Clouds	on mt.	10	10	Nim.
27	10 above.	St.		10	Nim.			Clouds	on mt.						Clouds	on mt.		1	Cir.
28	Clouds	on mt.		10		9	Nim.	4 above.	St.				4	Cir.	9 above.	St.		9	Nim.
29	Clouds	on mt.	10		St.	10	Nim.	Clouds	on mt.	10		Haze.	10	Nim.	Clouds	on mt.	5	2	Cu.
30	Clouds	on mt.		10		7	Nim.	Light	clouds.						Clouds	on mt.			

AMOUNT AND KIND OF CLOUDS.—DECEMBER, 1870.

Day of Month.	Mt. Washington. 7 A. M.		Lunenb'g 7 A. M.	Hanover, 7 A. M.		Gorham, 7 A. M.		Mt. Washington, 2 P. M.		Lunenb'g 2 P. M.	Hanover, 2 P. M.		Gorham, 2 P. M.		Mt. Washington, 9 P. M.		Lunenb'g 9 P. M.	Hanover, 9 P. M.	
	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.
1	2 below.	St.		2	Cu. & cir.	5	Cir.	3 below.	St.	10	10	Cu. cir.	5	Cir.	6 below.	St.	10		F.
2	Clouds	on mt.	5	10	Cir. cu.	7	Nim.	Clouds	on mt.	10			5	Cir.	Clouds	on mt.	10	8	St.
3	Clouds	on mt.		10	Cu.	10	Nim.	Clouds	on mt.		1	Cu.	5	Cir.	Clouds	on mt.			
4	Clouds	on mt.	10	10	Cu.			Clouds	on mt.	10	9	Cu. st.			Clouds	on mt.	10	10	Cu. cir.
5	1 ab've. 7 bel.	St.	5	10	F.	5	Nim.	Clouds	on mt.	10	10	Cir. cu.	10	Nim.	Clouds	on mt.	10	10	Cu. st.
6	Clouds	on mt.	10	10	St. cu.	10	Nim.	Clouds	on mt.	10	10	Cu. st.	10	Nim.	Clouds	on mt.	10	10	Cu. st.
7	Light	clouds.	10	10	St. cu.	9	Nim.	1 ab've, 8 bel.	St.	10	10	St.	5	Nim.	8 below.		10	10	Cu. st.
8	Light	clouds.	10	10	St. cu.			Clouds	on mt.	10	10	F.			Clouds	on mt.	10	10	Cu. st.
9	Clouds	on mt.	8	10	St. cn.	10	Nim.	Clouds	on mt.	10	10	Cu. st.	8	Nim.	Clouds	on mt.	10	10	Cu. st.
10	Light	clouds.	10	10	St. cu.	10	Nim.	Light	clouds.	10	1	St.	10	Nim.	Light	clouds.	4	10	Cu. st.
11	Light	clouds.	10	10	St. cu.	10	Nim.	Light	clouds.	10	10	F.	10	Nim.	1 ab've, 8 bel.	St, cir.	8	10	Cu. st.
12	Light	clouds.	10		F.	10	Nim.	Light	clouds.	10	10	Cu. st.	10	Nim.	Dense	clouds.	10	10	Cu. st.
13	Dense	clouds.	10		F.	10	Nim.	9 below.		10		F.	10	Nim.	Light	clouds.	10	10	Ou. st.
14	Dense	clouds.	10	10	St. & cu.	10	Nim.	Dense	clouds.	10	10	Cir. st.	10	Nim.	Clouds	on mt.	10	1	St.
15	Dense	clouds.	10	10	St. & cu.	10	Nim.	Dense	clouds.	10	10	Cu. st.			Dense	clouds.	10	1	St.
16	Dense	clouds.	8	2	St.	10	Nim.	Dense	clouds.	10	6	Cir. st.	10	Nim.	Light	clouds.	10	1	St.
17	8 below.		5	10	St. cu.	10	Nim.	Light	clouds.		10	Cu. st.	10	Nim.	Light	clouds.	10	10	Cu. st.
18	Dense	clouds.	10	10	St. cu.			Light	clouds.	5	4	Cir. st.			Dense	clouds.	10		
19	6 below.							1 above.	St.		3	Cir.	1	Cir.	5 above.		5	10	Cu. st.
20	Dense	clouds.	10	10	St.	10	Nim.	Dense	clouds.	10	10	Cu. st.	10	Nim.	Dense	clouds.	10	5	St.
21	Dense	clouds.	10	10	St.	10	Nim.	Dense	clouds.	10	6	Cu. st.	8	Nim.	Dense	clouds.	10	7	Cu. st.
22	Dense	clouds.	4			10	Nim.		Cir.		6	Cir.	5	Nim.	Dense	clouds.			
23	8 below.			10	St. cu.	10	Nim.	5 ab've 5 bel.	St.		10	Cu. st.			5 ab've, 2 bel.			1	St.
24	Light	clouds.	10	10	St. cu.			Light	clouds.		8	Cir. st.			5 above.				
25	10 bel., 1 ab've.							3 above.	St.		8	Cir. cu.			8 above.				
26	Light	clouds.	10	10	Cu.			Light	clouds.	10	8	Cir. st.			Dense	clouds.	10	8	Cu st.
27	Dense	clouds.	10	1	St.			8 above	St.	8	10	Cu. st.			10 ab've, 2 bel.	St.	10	4	St.
28	Dense	clouds.		10	St. cu.			Light	clouds.		10	Cu. st.			10 ab've, 3 bel.	Cu. st.		10	Cu. st.
29	Light	clouds.	10	10	St. cu.			5 above.	Cir.		10	Cu. st.			3 ab've, 3 bel.				
30	1 above.							8 above.	St.		10	Cir. st.			Light	clouds.	10	10	Cu. st.
31	Light	clouds.	10	10	St. cu.			Dense	clouds.	10	10	Cu. st.			Dense	clouds.	10	1	St.

AMOUNT AND KIND OF CLOUDS.—JANUARY, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenb'g 7 A. M.	Hanover. 7 A. M.		Gorham, 7 A. M.		.Mt. Washington, 2 A. M.		Lunenb'g 2 P. M.	Hanover, 2 P. M.		Gorham, 2 P. M.		Mt. Washington, 9 P. M.		Lunenb'g 9 P. M.	Hanover, 9 P. M.	
	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amonnt.	Kind.	Amount.	Amount.	Kind.
1	Light	clouds.	10	10	Nim.		Nim.	Clouds	on mt.	5	9	Cu. st.			Perfectly	clear.		9	Cir.cu.st.
2		Sleet.	10	10	Cu. st.	10	Nim.	Clouds	on mt.	10	10	Cir. st.	4	Nim.	Clouds	on mt.	5	9	" "
3	Light	clouds.				1	Nim.	8 ab've 5 bel.	St.	5	10	Cir. st.	5	Nim.	Clouds	on mt.	10	10	Cu. st.
4	4 below.						Nim.	Light	clouds.		8	Cir. cu. st.	1	Nim.	Light	clouds.		2	Cir. st.
5	Light	clouds.	10	10	Cu. st.	10	Nim.	Clouds	on mt.	10	10	Cu. st.	10	Nim.	8 above.	St.	10	7	Cir. st.
6	Clouds	on mt.	10	10	Cu. st.	10	Nim.	Clouds	on mt.	10	10	Cu. st.	10	Nim.	Clouds	on mt.	10		
7	Clouds	on mt.		10	Cu. st.	3	Nim.	1 above.	St.										
8	1 above.	St.				1	Cir.	7 above	Cir.		9	Cir. cu. st.	5	Cir.	1 above.	Cir.		3	Cir. st.
9	1 below.	St.						1 below.	St.										
10								5 above	St.		3	Cir. st.			5 above.			1	St.
11	3 above,	St.		4	Cir. cu.			Clouds	on mt.	10	10	Cir. st.	8	Nim.	Clouds	on mt.	10	10	Cu. st.
12	Clouds	on mt.	10	10	Cu. st.	10	Nim.	Clouds	on mt.	10	10	Cu. st.	10	Nim.	Clouds	on mt.	8	10	Cu. st.
13			10	10	Cir. st.	10	Nim.	10 ab've, 5 bel	St.		6	St.					5	2	St.
14	3 ab've, 2 bel.			10	St.	1	Nim.	Clouds	on mt.		9	Cu.			10 above.	St.	10	8	Cu. st.
15	Dense	clouds.	10	10	Cu.	10	Nim.	Clouds	on mt.	10	10	Cu. st.			Light	rain.	10	10	Cu. st.
16	Clouds	on mt.	10	10	Cu. st.	10	Nim.	Clouds	on mt.	10	10	Cu. st.			Clouds	on mt.	10	10	Cu. st.
17	Light	clouds.	10	3	St.	10	Nim.	4 below.	St.				5	Nim.		Clear.			
18	Light	clouds.		10	Cu. st.	5	Nim.	2 bel. 3 ab've	Cir.		9	Cu. st.	5	Nim.		Clear.			
19		Clear.						4 ab've, 1 bel	Cir. st.		10	Cir. cu. st.	5	Cir.	8 above.				
20	1 ab've 3 bel.	Cir. st.		10	Cir. cu. st.	5	Cir.	8 ab've 1 bel			10	Cir. cu. st.	8	Cir.		Hazy.	10	10	Cu. st.
21	Clouds	on mt.	10	10	Cu. st.	10	Nim.	Clouds	on mt.	10	8	Cir. cu. st.	10	Nim.	Clouds	on mt.	10	10	Cu. st.
22	Clouds	on mt.		10	Cir. st.			Clouds	on mt.		1	Cir.			2 above.				
23	2 below.							9 above.			10	Cu. st.			2 below.			10	Cu. st.
24	Clouds	on mt.	10	10	Cu. st.	10	Nim.	Clouds	on mt.	10		H. S.	10	Nim.	Clouds	on mt.	10		H.
25		Clear.		10	Cu. st.				Clear.							Clear.			
26	9 above.		10	10	Cu. st.	10	Cir.	10 above.		10	10	Cu. st.	10	Cir.	Clouds	on mt.	10	10	Cu. st.
27	Clouds	on mt.	10	10	Cu. st.	5	Nim.	Clouds	on mt.	10	6	Cir. cu. st.	4	Nim.	Clouds	on mt.		10	Cir.cu.st.
28	3 below.			9	Cir. cu. st.	5	Nim.	1 above.	Cir.		9	Cir. cu. st.	3	Cir.		Hazy.		10	Cu. st.
29	Light	clouds.	10	10	St.	10	Nim.	Light	clouds.	10	10	Cu. st.	10	Nim.	Clouds	on mt.	10	10	Cu. st.
30	Light	clouds.	10	10	Cu. st.	10	Nim.	10 ab've, 8 bel	St. cir.	10	10	Cu. st.	10	Nim. cir.	Very light	clouds.	10	10	Cu. st.
31	4 ab've 10 bel.	Cu. cir.	8	10	Cu. st.	5	Nim. cir.	8 ab., 8 bel.		10	10	Cu. st.	10	Nim.	Light	clouds.	10	10	Cu. st.

AMOUNT AND KIND OF CLOUDS.—FEBRUARY, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenb'g 7 A. M.	Hanover, 7 A. M.		Gorham, 7 A. M.		Mt. Washington, 2 P. M.		Lunenb'g 2 P. M.	Hanover, 2 P. M.		Gorham, 2 P. M.		Mt. Washington, 9 P. M.		Lunenb'g 9 P. M.	Hanover, 9 P. M.	
	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.
1	Light	clouds.	10	10	Cu.	10	Nim.	2 ab've 5 bel.	Cir., st.	5	10	Cu.	5	Nim.	1 below.	St.		10	Cu.
2	1 ab've 10 bel.	Cir.	8	10	Cu.	8	Nim.	8 ab've 3 bel.		10	10	Cu.	6	Cir., cu.	Light	clouds.	10	10	Cu.
3				2	St.	3	Nim.	Clouds	on mt.	5	10	Cu.	5	Nim.			10	8	Cu.
4			4	10	Cir. Cu. St.	10	Nim.	Clouds	on mt.		7	Cir. cu. st.	5	Nim.			10	2	St.
5	6 below.		10			8	Nim.	Light	clouds.		2	St.	5	Nim.	4 below.	Cu.			
6	4 below,	St.	10	9	Cir. Cu.	3	Nim.	4 below.											
7	3 ab've, 1 bel.	Cir., st.		3	St.			Clear.							Clear.			4	Cu.
8	8 above.		10	10	Cu. St.	5	Nim.	Clouds	on mt.	10	10	Cu.	10	Nim.	Clouds	on mt.	10	10	Cu. st.
9				10	Cu.	10	Nim.	Clouds	on mt.	10	10	Cu.	8	Nim.			10	10	Cu.
10			10	2	St.	6	Nim.	Clouds	on mt.		8	Cir. cu. st.	5	Nim.				1	St.
11	Clouds	on mt.				2	Nim.	Clouds	on mt.		1	St.	2	Nim.	5 below.	St.		2	St.
12			5	10	Cu. St.	6	Nim.	Light	clouds.	10	10	Cu.	10	Nim.	Clouds	on mt.	10	10	Cu. st.
13	Light	clouds.		10	Cu.	3	Nim.	8 below.		10			10	Nim.	1 below.	St.	10	1	St.
14	10 ab've, 5 bel.	St. cu.	10	10	Cu. St.	10	Nim.	2 ab've 8 bel.	Cir. cu.	10	10	Cu.	10	Nim.	Dense	clouds.	10	10	Cu.
15	10 below.			8	Cir. St.	10	Nim.	1 above.	Cir.		2	Cu. st.			9 above.	St.		10	Cu.
16		Cu.	8	10	Cu.	10	Nim.	Clouds	on mt.	10	10	Cu.	10	Nim.			10	10	Cu.
17	4 above.	Cu. & st.	10	10	Cu.			1 below.	St.		10	Cu.	2	Cir.	8 above.	St.	10		H.
18		Clouds.	10	10	Cu.	10	Nim.		Clouds.	10	10	Cu.	10	Nim.	Clouds	on mt.	10	10	Cu.
19	3 above.	Cir.		8	Cir. Cu.	5	Cir.	5 above.	Cir. st.		10	Cu.			Clouds	on mt.		10	Cu.
20			10	7	Cir. Cu.	10	Nim.	Dense	clouds.	6	10	Cu.	5	Nim.			10	2	St.
21	3 above.	Cir.																	
22	Clear.		10					Clear.							Clear.				
23	1 above.	St.						3 above.	Cir.	8	8	Cir. cu. st.			4 above.	Cir.		3	St.
24				10	Cu.			Clouds	on mt.	10	10	Cu.	5	Cir.			6	10	Cu.
25						5	Nim.	Clouds	on mt.	10	8	Cir. cu. st.	2	Nim.			5	7	Cir. st.
26	7 ab've, 8 bel.	St. cu.	10	10	Cu,	10	Cir.	7 above.	St.	10	10	Cu.	10	Nim.	Light	clouds.	10	10	Cu.
27			10		Hs.	10	Cir.	Clouds	on mt.		10	Cu.	10	Nim.			10		Hs.
28	Light	clouds.	8	2	St.	5	Cir.	4 below.	St.						Clear.			10	Cu

AMOUNT AND KIND OF CLOUDS.—MARCH, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenb'g 7 A. M.	Hanover, 7 A. M.		Mt. Washington, 2 P. M.		Lunenb'g 2 P. M.	Hanover, 2 P. M.		Mt. Washington. 9 P. M.		Lunenb'g 9 P. M.	Hanover, 9 P. M.	
	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Amonnt.	Kind.
1	Dense	clouds.	10	10	St.	Dense	clouds.	5	10	Cu. st.	Dense	clouds.	10	4	Cir. st.
2	1 above, 5 below.		10	8	Cir. cu. st.	8 ab've, 1 below.	St.	10	9	Cir. cu. st.	10 ab've hazy bel.	St.	10	2	Cu. st.
3	10 above, 0 below		10		H.	Light	clouds.	10		H.	Light	clouds.	10	10	Cu. st.
4	3 above, 5 below.	Cir. st. cu.	0	10	Cir. cu. st.	5 above.	Cir.	0	2	Cu. st.	10 ab've, 0 below.	St.	0	10	Cir. cu. st.
5	6 above.	Cir. & st.	0	5	Cir. st.	5 ab've, 0 below.	Cu.	0	1	St.	10 ab've, 0 below.	St.	0	10	Cir. cu. st.
6	Dense	clouds.	5	10	Cir. cu. st.	Dense	clouds.	10		H.	Light	clouds.	10	9	Cir. cu. st.
7	0 ab've, 6 below.	St.	0	0		1 ab've, 2 below.	Cu. st.	0	0		0		0	0	
8	10 ab've, 0 below.	St. & Nim	10	10	Cir. cu. st.	3 ab've, 1 below.	St. st.	10	1	Cir. st.	8 above.		10	10	Cir. cu. st.
9	Light	clouds.	10	10	Cu. st.	2 ab've, 1 below.	Cir. st.	0	10	Cu. st.	Clouds	on mt.	5	10	Cu. & st.
10	Clouds	on mt.	10	10	Cu. st.	Clouds	on mt.	10	10	Cu. st.	Clouds	on mt.	10	0	
11	4 ab've, 0 below.	Cir. & St.	0	6	Cir. cu. st.	5 ab've hazy bel.	Cir.& cir.st	0	3	Cir. st.	10 ab've, 3 below.		0	10	Cu. st.
12	Clouds	on mt.	0		Fog.	Clouds	on mt.	10	10	Cir. cu. st.	Clouds	on mt.	10	10	Cu. st.
13	5 ab've, 9 below.		0	0		3 above.	Cir. & st.	0	3	Cir. cu.	0 ab've, 9 below.		0	0	
14	1 ab've, 1 below.		0	0		Clouds	on mt.	10	9	Cir. cu.	Clouds	on mt.	10	6	Cu. st.
15	1 ab've, 3 below.	Cir. st.	0	10	Cir. cu. st.	10 ab've, 0 below.	Cir. & st.	10	10	Cir. cu.	8 ab've, 0 below.		5	10	Cu.
16	Clouds	on mt.	10	10	Cu.	Clouds	on mt.	10	10	Cu.	Clouds	on mt.	10	10	Cu.
17	Clouds	on mt.	10	10	Cu.	Clouds	on mt.	10	10	Cu.	Clouds	on mt.	10	10	Cu.
18	7 ab've, 3 below.	Cir. st.	8	10	Cir. cu.	8 ab've, 3 below.	Cir. st. cu.	0	10	Cir. cu.	0		0	0	
19	Clouds	on mt.	0	0		Clouds	on mt.	0	6	Cir. cu.	0 ab've, 3 below.	Cu.	0	0	
20	7 ab've, 0 below.	Cir. cu.	10	4	Cir. cu.	6 ab've hazy bel.	Cir. & st.	10	10	Cir. cu.	10 ab've, 5 below.	St. Cu.	10	8	Cu. cir.
21	Dense	clouds.	10	F		Dense	clouds.	10		F.	Dense	clouds.	10	F	
22	Dense	clouds.	10	7	Cir. cu.	Dense	clouds.	8	10	Cir. cu.	Dense	clouds.	9	10	Cu.
23	4 ab've, 3 below.	Cir. st. st.	10	10	Cu.	Dense	clouds.	10	10	Cu.	Dense	clouds.	10	10	Cu.
24	Clouds	on mt.	10	10	Cu.	Dense	clouds.	10	5	Cir. cu.	Dense	clouds.	10	10	Cu.
25	Clouds	on mt.	0	0		Dense	clouds.	0	7	Cir. cu.	Dense	clouds.	0	0	
26	Clouds	on mt.	0	0		1 below, 0 ab've.	St.	0	8	Cir. cu.	Hazy.		0	10	Cu.
27	Clouds	on mt.	10	10	Cu. st.	Clouds	on mt.	10	10	Cu. st.	Clouds	on mt.	10	10	Cu. & st.
28	Clouds	on mt.	10	10	Cu.	Clouds	on mt.	10	3	Cir. cu.	Clouds	on mt.	0	0	
29	0		0	0		0		0	0		0		0	0	
30	1 ab've hazy bel.		5	10	Cu.	Clouds	on mt.	8	7	Cir. cu.	Clouds	on mt.	0	10	Cu.
31	1 ab've, 5 below.	Cir. st. cu.	0	0		1 ab've, 0 below.	St.	0	0		0		0	0	

AMOUNT AND KIND OF CLOUDS.—APRIL, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenb'g 7 A. M.	Hanover, 7 A. M.		Mt. Washington, 2 P. M.		Lunenb'g 2 P. M.	Hanover, 2 P. M.		Mt. Washington, 9 P. M.		Lunenb'g 9 P. M.	Hanover, 9 P. M.	
	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.	Amount.	Kind.	Amount.	Amount.	Kind.
1	1 ab've, 0 below.	Cir.	0	0		8 above, 0 below.	Cu. & st.	0	10	Cu.	10 ab've, 0 below.	St.	5	10	Cu.
2	10 ab've hazy bel.	Cu.	10	10	Cu.	4 ab've, 0 below.	Cu. & st.	0	7	Cir. cu.	0		0	0	
3	5 ab've hazy bel.	Cir.	0	6	Cir. cu.	8 ab've hazy bel.		6	10	Cu.	Clouds	on mt.	10	10	Cu.
4	Dense	clouds.	10	10	Cu.	3 ab've, 10 below	Cir. st.	10	10	Cir. cu.	Clouds	on mt.	10	6	Cir. cu.
5	Dense	clouds.	10	8	Cir. cu.	Dense	clouds.	10	1	Cu.	0 ab've, 5 below.	Cu.	4	0	
6	0		0	0		3 ab've, 0 below.	Cir.	0	0		2 ab've, 0 below.	St.	0	0	
7	Dense	clouds.	10	8	Cir. cu.	Clouds	on mt.	5	9	Cir. cu.	Dense	clouds.	0	8	Cir. cu.
8	Dense	clouds.	0	3	Cir. cu.	10 ab've hazy bel.	St.	0	H		Light	clouds.	5	1	St.
9	9 ab've, 5 below.	St. st.	0	10	Cu.	3 ab've, 4 below.	Cir. st. st.	10	10	Cu.	8 ab've, 4 below.	Cir. st. st.	10	10	Cir. cu.
10	Light	clouds.	0	1	Cir.	8 ab've hazy bel.	Cir & st.	0	10	Cu.	4 ab've, 2 below.		0	10	Cu.
11	Clouds	on mt.	10	10	Cu.	Clouds	on mt.	10	10	Cir. cu.	Clouds	on mt.	10	10	Cu.
12	Clouds	on mt.	10	10	Cu.	Clouds	on mt.	10	10	Cir. cu.	Clouds	on mt.	10	10	Cir. cu.
13	Clouds	on mt.	0	7	Cir. cu.	Clouds	on mt.	0	10	Cir. cu.	Light	clouds.	8	10	Cir. cu.
14	0 ab've, 8 below.	St. cir.	10	F		Clouds	on mt.	0	6	Cir. cu.	9 ⅛ ab've, 2 bel.		0	0	
15	3 ab've, 4 below.	St. st.	0	6	Cir. cu.	10 ab've, 2 below.		10	9	Cir. cu.	Clouds	on mt.	10	10	Cir. cu.
16	Clouds	on mt.	10	10	Cir. cu.	Clouds	on mt.	10	10	Cir. cu.	Clouds	on mt.	10	10	Cir. cu.
17	Clouds	on mt.	10	9	Cir. cu.	Clouds	on mt.	10	10	Cir. cu.	Clouds	on mt.	10	10	Cir. cu.
18	Light	clouds.	10	10	Cir. cu.	Clouds	on mt.	10	7	Cir. cu.	Clouds	on mt.	0	2	Cu. St.
19	0 ab've, 1 below.	St.	0	0		4 above, 0 below.	Cu.	0	10	Cir. cu.	10 ab've, 0 below.	St.	10	10	Cir. cu.
20	Clouds	on mt.	10	10	Cir. cu.	Clouds	on mt.	10	10	Cir. cu.	Clouds	on mt.	10	10	Cir. cu.
21	Light	clouds.	0	F		7 ab've hazy bel.	Cir. & St.	10	10	Cu.	Clouds	on mt.	10	10	Cu.
22	Clouds	on mt.	10	F		Clouds	on mt.	10	10	Cir. cu.	9 ab've, 0 below.		0	8	Cu. st.
23	Clouds	on mt.	10	10	Cu.	Clouds	on mt.	8	9	Cir. cu.	Clouds	on mt.	10	1	Cir.
24	Light	clouds.	0	0		Clouds	on mt.	0	8	Cir. cu.	Clouds	on mt.	0	0	
25	6 ab've, 0 below.	St.	10	10	Cu.	10 ab've hazy bel.		5	10	Cu.	Clouds	on mt.	0	4	Cir. cu.
26	0 ab've, 7 below.	Cu.	0	1	Cu. st.	3 ab've, 0 below.	St. & Cir.	0	0		0		0	0	
27	Hazy ab've 3 bel.	St.	0	H		9 ab've. 2 below.		5	10	Cu.	Clouds	on mt.	10	10	Cu.
28	Clouds	on mt.	10	10	Cu.	Clouds	on mt.	10	10	Cu.	Clouds	on mt.	10	10	Cu.
29	2 ab've, 7 below.	St. st.	4	F		6 ab've, 9 below.	Cir. st. cu.	0	3	Cir. cu.	Hazy ab., 10 bel.		0	8	Cir. cu.
30	Clouds	on mt.	10	10	Cu.	Clouds	on mt.	10	10	Cir. cu.	Clouds	on mt.	5	4	Cir. cu.

AMOUNT AND KIND OF CLOUDS.—MAY, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Lunenb'g 7 A. M.		Hanover, 7 A. M.		Mt. Washington, 2 P. M.		Lunenb'g 2 P. M.		Hanover, 2 P. M.		Mt. Washington, 9 P. M.		Lunenb'g 9 P. M.		Hanover, 9 P. M.	
	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.
1	0 above, 10 bel.	Cu.	8	Cir.	10	Cu.	Clouds	on mt.	0		9	Cir. cu.	Clouds	on mt.	10		10	Cir. cu.
2	0 above, 4 bel.	St.	0		2	Cu.	Clouds	on mt.	0		8	Cir. cu.	10 ab've, 0 below.	St.	0		9	Cir.
3	Clouds	on mt.	10	Cir.	10	Cir.	Clouds	on mt.	10	Nim.	10	Cu.	10 ab've, 0 below.		10	Cu. st.	10	Cu.
4	Clouds	on mt.	10	Nim.	10	Cu.	Clouds	on mt.	10	Nim.	10	Cu.	Clouds	on mt.	10	Nim.	10	Cu.
5	Clouds	on mt.	10	Nim.	10	Cu.	Clouds	on mt.	10	Nim.	10	Cu.	10 ab've, 3 below.		0		10	Cir. cu.
6	0 ab've, 8 below.	St.	0		4	Cir. cu.	2 ab've, 7 below.	Cir. st.	0		7	Cir. cu.	7 ab've, 10 below.		5	Cu.	10	Cir. cu.
7	Clouds	on mt.	10	Nim.	10	Cu.	Clouds	on mt.	5	Cir.	10	Cu.	Clouds	on mt.	0		2	St.
8	Clouds	on mt.	10	Nim.	10	Cir. cu.	Clouds	on mt.	10	Nim.	10	Cir. cu.	Clouds	on mt.	10	Nim.	10	Cu. st.
9	1 ab've, 8 below.	Cir. st.	10	Nim.	10	Cir. cu.	Light clouds	on mt.	0		9	Cir. cu.	4 ab've, 10 below.	St. st.	0		2	Cu. st.
10	0 ab've, 2 below.	St.	6	Cir.	8	Cir. cu.	Clouds	on mt.	0		4	Cir. cu.	Clouds	on mt.	0		0	
11	0 ab've, 1 below,	and hazy.	0		0		10 ab've, 3 below.		5	Cir.	10	Cir. cu.	10 ab've, 0 below.		0		2	St.
12	Clouds	on mt.	0		0		6 ab. hazy below.	St.	0		7	Cir. cu.	3 ab've, 0 below.		0		2	St.
13	Clouds	on mt.	0		9	Cir. cu.	5 ab've, 0 below.		5	Cir.	0		Clouds	on mt.	10	Cir. cu.	2	St.
14	Clouds	on mt.	8	Cir.	10	Cir. cu .st.	Dense clouds	on mt.	10	Cir. cu.	8	Cir. cu.	Dense clouds	on mt.	10	Cir. cu.	10	Cir. cu.
15	Light clouds	on mt.	0		2	Cir.	2 ab've, 1 below.	Cir.	0		0		0		0		0	
16	0 ab've, hazy bel.		..	....	H		4 ab. hazy below.	Cir.	..	....		Haze.	0 ab. h'zy & d'nse	below.	..	....	10	Cu.
17	Clouds	on mt.	..	....	10	Cir. cu.	Cloud	on mt.	..	....	6	Cir. cu.	Light clouds	on mt.	..	....	10	Cir. cu.
18	0 ab've, 8 below.	St.	..	....	7	Cir. cu.	1 ab've, 0 below.	Cir.	..	....	0		0 ab. hazy below.		..	....	3	H.
19	5 ab've, hazy bel.	Cir. cu.	..	....	10	Cir. cu.	5 ab. hazy below.		..	....		Haze.	5 ab. h'zy & d'nse	below. St.	..	....	H	
20	3 ab've, hazy bel.	Cir.	..	....	3	Haze.	1 ab. hazy below.	Cir.	..	....	H		0 ab. ha'y & d'nse	below.	..	....	H	
21	2 ab., dense mist	bel. Cir.	..	....	H		9 ab. hazy below.		..	....	H		9 above. Hazy at	horizon.	..	....	4	H.
22	1 ab've, hazy bel.	Cir.	..	....	H		Hazy below.		..	....	H		9 ab've, 0 below.	St.	..	....	H	
23	Dense cloud	on mt.	..	....	H		Dense cloud	on mt.	..	....	3	Cir. cu.	0 ab've, 2 below.	Nim.	..	....	4	H.
24	0 ab've, hazy bel.		..	....	0		3 ab. hazy below.	Cir.	..	....	10	Cir. cu.	1 ab. hazy below.	St.	..	....	0	
25	1 ab've, 3 below.	Cir. st.	..	....	0		4 ab. dense haze	bel. Cir.	..	....	4	Cir.	10 ab. h'zy below.	St.	..	....	0	
26	10 ab've, hazy b'l.	St.	..	....	10	Cu.	9 ab. hazy below.	St.	..	....	6	Cir. cu.	3 ab've, 0 below.	Nim.	..	....	0	
27	Dense cloud	on mt.	..	....	3	Cir.	0 ab've, 0 below.		..	....	4	Cir.	10 ab. h'zy below.	St.	..	....	4	Cir. cu.
28	10 ab., slight haze	below.	..	....	10	Cir. cu.	10 ab. 1 bel. Dense	cl's on mt.	..	....	10	Cir. cu.	9 ab. hazy below.	St.	..	....	0	
29	10 above. Cloud	on mt. St.	..	....	H		2 ab. hazy below.	Cir.	..	....	1	Cir.	6 ab hazy below.	St.	..	....	6	Cir. cu.
30	Dense cloud	on mt.	..	....	9	Cir. cu.	7 ab. hazy below.	Cir.	..	....	5	Cir. cu. nim	Dense clouds	on mt	..	....	10	Cir. cu.
31	Dense cloud	on mt.	..	....	F		Dense	Cloud.	..	....	10	Cir. cu.	0 ab've, 10 below.	St.	..	....	9	Cir. cu.

AMOUNT AND KIND OF CLOUDS.—JUNE, 1871.

Day of Month.	Mt. Washington, 7 A. M.		Hanover, 7 A. M.		Mt. Washington, 2 P. M.		Hanover, 2 P. M.		Mt. Washington, 9 P. M.		Hanover, 9 P. M.	
	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Kind.
1	1 above, 0 below.	Cir. hazy.	8	Cir. cu.	0 ab've, hazy below.		1	Cir.	10 above, 1 below.	Cu. & st.	4	Cir. st.
2	8 above.	St. hazy bel.	3	St.	5 above.	Hazy below.	5	Cir. cu.	3 above, hazy below.	Cu.	6	Cir. cu.
3	0 above.	Hazy below.	0		9 above, hazy below.	Cu. st.	3	Cir.	Cloudy	on mt.	10	Cu.
4	2 above, 0 below.	Cir.	10	Cu.	6 above, 0 below.	Cir. & st.	9	Cir. cu.	6 above, 0 below.	Cu.	1	Cir.
5	0 above. Hazy	at horizon.	0		0 above, 0 below.		0		2 above, 0 below.	Cir. & cu. st.	0	
6	2 above, 0 below.	Cir.	7	Cir.	10 above, 0 below.	Cir. & st.	10	Cir. cu.	10 above, 0 below.	Cir. st.	6	Cir. cu.
7	10 above, 0 below.	Cir. st.	10	Cir. cu.	Dense	clouds on mt.	10	Cir. cu.	Dense	clouds on mt.	8	Cir. cu.
8	Dense	clouds on mt.	10	Cir. cu.	10 above, hazy below.	Cir. & st.	10	Cir. cu.	0 above, 0 below.		0	
9	Dense	clouds on mt.	8	Cir. cu.	Clouds	on mt.	9	Cir. cu.	7 above, 0 below.	Cu.	0	
10	0 above, 0 below.			Fog.	3 above, 0 below.	Cir. cu.	8	Cir. cu.	3 above. 0 below.	Cir. cu.	5	Cu.
11	Dense	clouds on mt.	10	Cu.	Dense	clouds on mt.	9	Cir. cu.	3 above, 5 below.	Cir. st.	2	St.
12	Dense	clouds on mt.	10	Cu.	Dense	clouds on mt.	10	Cir. cu.	Dense	clouds on mt.	9	Cir. cu.
13	Dense	clouds on mt.	0		Light	clouds on mt.	10	Cu.	Dense	clouds on mt.	4	Nim.
14		Clouds on mt.	0		Dense	clouds on mt.	10	Cu.	Dense	clouds on mt.	2	St.
15	Dense	clouds on mt.	10	Cir. cu.	Light	clouds on mt.	10	Cu.	0 above, 3 below.	cu.	2	St.
16	Light	clouds on mt.	F		3 above, 0 below.	Cir. cu.	8	Cir. cu.	Cloudy	on mt.	9	Cir. cu.
17	0 above, 3 below.		0		3 above, 1 below.	Cu. st.	9	Cir. cu.	0 above, 2 below.		7	Cu.
18	Dense	clouds on mt.	10	Cu.	Dense	clouds on mt.	10	Cu.	Dense	clouds on mt.	10	Cu.
19	Dense	clouds on mt.	10	Cu.	Dense	clouds on mt.	10	Cu.	0 above, 10 below.	St.	1	St.
20	Dense	clouds on mt.	4	Cir. st.	1 above, hazy below.	Cir. st.	10	Cir. st.	Dense	clouds on mt.	10	St.
21	Dense	clouds on mt.	1	St.	3 above, 0 below.		2	Cir.	Dense	clouds on mt.	0	
22	Clouds	on mt.	8	Cir. cu.	10 above.	Hazy below.	4	Cir.	2 above, hazy below.		0	
23	Dense	clouds on mt.	0		Dense	clouds on mt.	8	Cir. st.	Dense	clouds on mt.	0	
24	10 above, 0 below.		10	St.	10 above.	Hazy below.	10	St.	2 above, 0 below.		1	St.
25	2 above, 0 below.			Fog.	3 above, 0 below.		0		1 above, 0 below.	Cu.	1	St.
26	0 above.	Hazy below.	6	Cir.	4 above.	Hazy below.		Haze.	0 above, 1 below.	St.	0	
27	8 above, hazy below.			Haze.	4 above.	Hazy below.	5	Cir.	Dense	clouds on mt.	7	Cir. cu.
28	Dense	clouds on mt.	10	St.	1 above.	Hazy bel. cu.		Haze.	5 above, hazy below.			Haze.
29	Dense	clouds on mt.	4	Cu. st.	Dense	clouds on mt.	10	Cir. cu.	Dense	clouds on mt.	0	
30	0 above, hazy below.		0		7 above, hazy below.	Cir.	5	Cir. cu.	9 above. 0 below.	Cir.	9	Cir. cu.

RELATIVE HUMIDITY.—JANUARY, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Hanover, 7 A. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 2 P. M.	Hanover, 2 P. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Hanover, 9 P. M.	Mt. Washington, 10 P. M.
1	46	70.2	46.0	2	60.7	....	87	36.9	75.7	36.9
2	100	100.0	100.0	56	76.7	79.1	10	77	51.0	77.7
3	28	60.8	28.4	43	55.4	36.9	47	39	72.1	43.8
4	33	....	33.5	60	67.1	44.9	47	44	100.0	44.9
5	34	100.0	34.5	79	86.8	81.0	63	84	74.0	84.0
6	100	90.0	100.0	82	94.8	82.9	80	77	94.5	77.7
7	61	67.1	61.1	61	41.8	57.7	54	15	92.0	15.6
8	22	100.0	22.5	28	52.0	62.7	....	62	87.7	62.7
9	22	83.9	22.5	31	88.0	19.1	20	53	75.1	53.9
10	34	100.0	34.5	39	76.0	28.6	48	48	100.0	48.0
11	81	100.0	81.0	100	81.6	87.6	87	87	85.0	100.0
12	89	86.8	89.3	89	94.6	100.0	100	94	89.3	94.7
13	89	89.5	89.5	90	70.6	90.0	90	94	89.5	89.3
14	94	100.0	100.0	89	82.2	89.5	100	89	90.0	89.5
15	100	90.0	100.0	100	95.1	100.0	100	100	89.9	100.0
16	100	100.0	100.0	100	100.0	100.0	100	100	97.1	100.0
17	41	77.2	41.6	55	55.6	55.3	46	61	71.2	68.3
18	36	65.8	28.4	70	55.6	68.3	67	39	79.1	39.3
19	46	100.0	48.0	59	69.2	58.2	58	67	80.2	47.0
20	46	92.1	64.8	74	71.6	82.3	63	46	81.8	64.8
21	81	100.0	81.6	82	75.6	80.4	81	76	100.0	77.7
22	25	72.1	53.9	100	95.1	?	18	....	100.0	?
23	....	100.0	?	28	83.4	68.3	....	55	89.4	39.3
24	84	98.1	39.3	39	100.0	67.1	64	15	100.0	55.7
25	....	76.0	?	....	68.8	?	....	...	87.4	?
26	39	77.0	39.3	50	100.0	82.9	36	64	100.0	76.0
27	50	93.2	50.0	65	84.0	62.7	56	23	100.0	?
28	....	88.6	19.4	53	80.0	67.1	61	43	91.3	46.0
29	46	100.0	73.0	64	100.0	75.0	....	66	93.2	77.7
30	76	92.9	76.9	62	94.9	62.3	62	79	78.2	79.7
31	86	79.2	86.8	93	85.3	89.6	89	89	89.5	89.5

RELATIVE HUMIDITY.—FEBRUARY, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Hanover. 7 A. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 2 P. M.	Hanover, 2 P. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Hanover, 9 P. M.	Mt. Washington, 10 P. M.
1	84.5	71.9	84.0	70.2	66.9	84.0	82	82.9	69.4	82.9
2	82.9	78.8	82.9	82.3	70.5	90.7	90	81.0	79.2	81.0
3	....	77.7	?	65.8	62.2	68.3	75	75.0	83.9	75.0
4	....	85.6	?	....	67.1	?	45	....	53.9	?
5	54.4	100.0	....	29.5	61.1	76.5	....	68.3	61.1	68.3
6	89.4	80.3	89.4	81.0	90.0	78.4	58	66.8	87.7	64.8
7	81.6	84.5	73.0	65.9	92.4	64.8	100	78.7	91.0	100.0
8	64.8	82.3	64.8	81.6	88.3	83.4	83	84.0	81.8	100.0
9	100.0	94.0	84.0	70.2	89.8	100.0	....	84.0	80.2	83.4
10	69.5	74.6	69.5	47.6	72.1	61.1	76	55.7	82.9	55.7
11	...	63.3	?	19.4	82.9	44.9	73	15.6	88.2	15.6
12	67.1	22.8	67.1	81.6	90.1	77.7	....	89.0	100.0	89.0
13	69.5	100.0	69.5	87.2	70.2	75.0	....	60.2	89.4	60.2
14	76.9	83.9	76.9	81.6	90.1	62.3	78	77.7	91.3	77.7
15	39.3	100.0	39.3	62.3	92.9	81.6	83	70.2	78.0	70.2
16	100.0	92.9	100.0	78.7	89.6	82.3	87	78.4	74.0	78.4
17	48.0	100.0	48.0	80.4	57.7	71.1	80	63.5	69.9	63.5
18	72.1	94.5	81.0	94.0	90.7	100.0	....	83.4	61.0	83.4
19	25.7	72.1	25.7	50.0	48.3	50.0	....	73.0	69.2	48.0
20	46.0	92.1	46.0	61.8	89.3	46.0	....	58.6	75.4	71.8
21	43.8	79.1	43.8	65.8	55.3	53.9	....	38.3	53.8	78.5
22	74.0	80.3	48.0	67.1	55.3	36.9	59	22.0	77.7	53.8
23	67.1	100.0	67.1	69.2	77.1	69.2	79	74.6	74.6	86.8
24	89.8	88.7	89.8	89.8	86.0	89.3	....	89.5	94.5	89.3
25	100.0	65.3	100.0	69.2	45.9	67.1	....	81.0	52.7	81.0
26	64.7	82.9	64.7	71.2	62 8	73.8	73	87.2	70.5	87.2
27	100.0	94.7	100.0	100.0	90.5	80.4	73	76.0	88.7	76.0
28	15.6	54.1	15.6	55.3	50.0	15.3	44	55.3	87.2	58.2

RELATIVE HUMIDITY.—MARCH, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Hanover, 7 A. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 2 P. M.	Hanover, 2 P. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Hanover, 9 P. M.	Mt. Washington, 10 P. M.
1	73.0	72.5	82.9	82.9	56.7	82.3	82	79.7	62.8	79.7
2	62.3	73.3	62.3	74.8	61.9	84.0	86	86.8	55.7	87.2
3	89.3	90.0	89.5	90.2	100	94.8	100	84.5	71.9	84.0
4	84.0	66.5	84.0	77.2	47.6	75.7	—	64.8	60.6	73.0
5	59.6	63.4	59.1	75.7	46.3	65.9	66	81.6	70.3	81.1
6	84.0	89.3	84.5	85.5	100	84.0	82	83.4	80.2	84.0
7	53.8	73.8	53.8	82.9	43.2	82.3	82	68.2	76.8	68.2
8	86.8	94.5	86.8	89.4	45.9	89.0	89	83.9	64.5	84.3
9	94.7	90.3	89.5	86.3	84.0	80.7	90	94.7	96.2	94.8
10	90.0	89.7	90.0	94.9	96.2	89.3	100	86.8	82.0	86.8
11	87.2	89.3	81.8	83.4	41.1	88.3	100	88.2	85.0	78.2
12	94.8	98.0	89.5	94.8	78.0	94.8	94	89.3	80.2	89.6
13	91.0	62.8	83.4	84.0	34.4	73.0	81	81.6	65.3	81.6
14	58.2	59.4	53.8	79.1	32.8	79.1	88	79.6	60.6	76.9
15	75.0	88.0	52.0	68.2	40.7	68.2	71	69.2	61.0	69.2
16	87.2	94.7	88.3	89.5	80.2	94.8	90	94.7	85.2	94.7
17	90.5	89.5	90.7	96.6	83.6	91.2	90	90.7	100	90.7
18	70.2	44.2	70.2	86.8	54.3	73.8	69	84.5	79.7	69.2
19	84.5	89.3	84.5	81.0	42.0	70.1	68	90.7	56.9	73.0
20	70.2	78.2	58.4	75.7	42.0	67.5	65	73.8	64.9	80.7
21	87.2	94.7	87.2	94.8	100	89.3	87	85.0	100	84.5
22	79.7	59.4	80.4	80.4	56.8	79.7	79	78.4	69.4	78.4
23	63.5	78.2	63.5	86.0	89.3	85.5	87	86.0	100	86.0
24	43.8	62.2	43.8	64.5	63.4	34.5	67	48.3	56.9	48.0
25	36.9	43.3	34.5	45.0	34.0	48.0	50	52.0	30.2	52.0
26	50.0	84.3	52.0	63.5	29.6	63.5	64	64.8	61.7	64.8
27	79.1	88.7	79.6	69.2	100	59.7	54	55.3	100	55.3
28	55.3	86.4	55.3	58.2	56.9	58.2	67	75.0	58.4	58.2
29	41.6	71.1	41.1	68.2	79.2	58.2	67	58.2	62.2	58.2
30	65.9	62.2	65.9	83.4	45.9	68.2	74	75.7	71.9	75.7
31	63.5	84.1	63.5	69.2	40.8	67.1	50	73.0	55.6	73.0

RELATIVE HUMIDITY—APRIL, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Hanover, 7 A. M.	Mt. Washington, 7:57 A. M.	Mt. Washington, 2 P. M.	Hanover, 2 P. M.	Mt. Washington, 4:57 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Hanover, 9 P. M.	Mt. Washington, 10 P. M.
1	59	73.8	62.3	77	28.3	76.5	64	53	65.9	70.1
2	70	78.2	59.6	73	46.6	84.0	74	64	89.6	61.0
3	70	100	62.2	78	62.3	82.9	86	74	85.6	80.7
4	87	100	87.6	87	73.2	80.6	92	86	86.3	86.1
5	59	97.1	59.6	48	52.4	48.1	48	50	40.5	49.9
6	50	64.4	52.0	68	22.9	63.5	46	65	69.4	64.8
7	89	65.3	89.5	91	46.8	91.2	91	91	67.8	91.6
8	91	86.1	91.1	88	37.0	88.3	92	92	50.3	92.0
9	82	64.0	95.6	76	52.9	83.3	91	81	80.7	81.1
10	89	39.9	89.3	81	27.6	87.6	86	93	50.1	93.3
11	94	82.0	94.1	87	77.3	88.0	88	94	100	88.7
12	78	100	100	85	47.8	84.5	94	82	54.7	82.9
13	81	80.2	81.6	85	51.2	86.4	86	92	83.3	92.9
14	79	99.0	89.6	75	37.5	77.5	71	71	76.8	92.1
15	85	100	72.1	73	32.0	88.7	86	86	64.1	86.4
16	73	75.0	87.2	87	46.6	88.7	86	85	81.6	85.5
17	87	90.3	88.0	53	56.5	86.4	92	85	57.7	86.0
18	85	90.5	70.2	86	29.9	80.0	85	86	69.9	85.0
19	85	66.9	70.2	83	38.8	84.1	83	88	53.4	88.3
20	94	91.0	100	90	86.9	91.0	90	88	100	95.0
21	83	100	83.4	79	55.3	100	89	83	98.0	83.4
22	89	100	83.9	89	71.0	88.7	86	93	97.0	86.4
23	86	74.4	86.4	92	42.9	84.0	—	90	51.2	90.4
24	79	41.4	80.4	84	35.9	84.5	84	84	66.9	84.0
25	54	96.0	54.1	81	39.0	94.0	—	87	63.8	87.2
26	63	35.7	63.5	85	86.1	93.1	69	69	66.9	68.2
27	86	84.9	86.8	76	59.0	93.8	92	68	81.6	68.2
28	100	81.6	100	100	75.6	100	95	94	86.6	94.7
29	90	97.0	91.0	62	59.2	74.4	79	94	79.4	94.8
30	39	91.8	88.0	89	64.0	94.7	94	93	92.0	94.5
31										

RELATIVE HUMIDITY.—MAY, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Hanover, 7 A. M.	Mt. Washington, 2 P. M.	Hanover, 2 P. M.	Mt. Washington, 7 P. M.	Mt. Washington, 9 P. M.	Hanover, 9 P. M.
1	88.0	84.0	94.3	43.2	88	94.1	57.0
2	87.0	79.0	79.2	42.1	87	87.2	61.1
3	88.3	76.7	94.5	81.1	..	73.8	95.7
4	85.5	100.0	86.0	100.0	86	85.5	100.0
5	86.4	100.0	89.8	95.6	..	90.5	95.4
6	84.9	73.7	92.0	53.7	84	80.2	71.6
7	87.2	100.0	93.3	38.6	95	92.4	95.7
8	82.3	56.7	84.0	45.4	84	78.0	78.4
9	70.2	68.4	68.9	29.2	86	92.9	82.9
10	93.3	87.3	93.6	27.6	93	85.5	73.2
11	85.0	56.3	88.0	34.6	87	94.1	47.2
12	88.0	55.2	94.9	25.6	..	80.0	54.5
13	88.3	63.8	88.0	28.4	..	81.6	45.0
14	70.1	45.0	67.1	38.5	..	71.2	80.7
15	82.3	46.1	78.0	11.8	..	85.5	76.2
16	58.4	60.7	48.8	19.3	..	62.8	45.2
17	100.	82.9	82.4	56.1	..	78.7	48.3
18	70.2	50.0	87.6	27.2	..	87.2	52.3
19	88.0	74.3	62.8	32.9	..	66.1	52.9
20	65.3	56.1	37.5	31.2	..	61.1	63.2
21	85.9	75.1	67.0	43.5	..	69.6	58.2
22	82.2	60.3	85.0	71.7	..	89.6	88.4
23	94.8	66.0	86.8	41.1	..	87.2	69.8
24	74.8	27.6	76.1	60.2	..	80.7	54.3
25	92.5	59.0	99.3	88.2	..	51.5	51.4
26	100.	89.0	92.0	39.5	..	75.0	48.7
27	100.	35.8	95.9	24.0	..	75.0	41.1
28	88.0	81.9	68.5	84.7	.	77.5	86.9
29	92.3	50.2	73.2	43.5	..	87.8	55.1
30	93.5	61.1	83.9	44.1	..	93.0	89.5
31	23.5	98.0	83.9	100.0	..	91.2	88.2

RELATIVE HUMIDITY.—JUNE, 1871.

Day of Month.	Mt. Washington, 7 A. M.	Hanover, 7. A. M.	Mt. Washington, 2 P. M.	Hanover, 2 P. M.	Mt. Washington, 9 P. M.	Hanover, 9 P. M.
1	51	85.7	74	47.2	85	64.7
2	89	75.1	87	85.0	84	80.7
3	74	72.0	82	40.5	85	71.6
4	86	89.0	65	58.0	86	89.1
5	74	72.7	78	78.0	58	68.9
6	58	80.5	55	56.9	60	72.7
7	54	75.5	93	89.6	93	92.1
8	91	77.0	54	50.2	84	59.5
9	95	54.6	87	49.0	62	76.3
10	63	92.6	70	49.0	83	67.0
11	88	80.5	85	63.4	83	62.5
12	86	87.8	95	72.7	100	70.3
13	100	52.7	100	77.6	90	60.2
14	100	61.9	88	47.0	89	68.7
15	90	73.4	81	57.5	84	93.2
16	79	92.7	89	37.5	90	51.2
17	88	56.1	62	83.6	90	68.1
18	81	85.9	91	100.0	96	100.0
19	92	93.4	93	69.5	85	88.2
20	100	86.2	86	59.9	82	71.8
21	84	63.5	91	36.4	77	51.8
22	89	73.3	80	38.1	91	60.6
23	100	61.5	90	79.1	79	66.0
24	70	85.9	64	93.4	81	92.9
25	83	92.9	47	49.7	76	67.0
26	100	68.0	72	51.4	70	64.2
27	84	80.2	66	81.7	72	70.4
28	93	83.3	22	41.2	68	72.7
29	63	83.1	78	50.7	90	62.0
30	100	62.3	48	75.2	90	68.1
	...		...		..	

RECORD OF RAIN AND SNOW.—NOVEMBER, 1870.

Day of Month.	MOUNT WASHINGTON.				LUNENBURG.				HANOVER.			
	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	D'pth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in gauge in inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.
13						7 A. M.	1	2				
14					6 P. M.				Rain at 4:45 P. M.	Turns to a melting	.15	
15						2 A. M.	1-2	2		snow at night.		
16												
17									Slight aurora.			
18	Snowing, 1 P. M. and	during night.			4 P. M.				4:30 P. M., Gentle	rain; snow in ev'g.		.06
19	12 1-2 " "	during night.				6 P. M.		8	Flurries of snow;	ground white.		
20												
21	Snowing 11 A. M.				Snow squalls.							
22	Snow and sleet du	ring night.							7 P. M.	10 P. M. Hails		
23	Sleet.				Shower.	4 A. M.	1-4			moderately.		
24	Sleet.											
25												
26									Rain in night and	early morning.	.24	
27	Sleet.											
28												
29	Snowing, 6 A. M.	8 P. M.			4 A. M.	2 P. M.			Rain during the	morning.	.10	
30												
						Amount,	1 3-4	12		Amount,	.49	.06

RECORD OF RAIN AND SNOW.—DECEMBER, 1870.

Day of Month.	MOUNT WASHINGTON.				LUNENBURG.				HANOVER.			
	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in Inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in Inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in Inches.	Depth of Snow in in.
1												
2					8 A. M., slight snow	storm.			Conspicuous halo	around moon.		
3									Slight sprinkle of	rain during night.		
4									Very little snow.			
5												
6					9 A. M.	5 P. M.		.25	Gentle rain all day.		.10	
7												
8					10 A. M.	4 P. M.			Snow in early m'rn	ing and in the P. M.		.75
9												
10								.5	Little snow during	night.		
11									Drizzle at noon.			
12					11 A. M.				1:15 P. M. & 9 P.M.	rain-mist at dawn.	.22	
13						8 A. M.	.5	.25	Hail and rain in	night.	.18	
14	8 A. M. snow.,	6 P. M.			4 P. M.							
15						6 A. M.		2.	Slight snow in A.	M.—Aurora.		
16					Snow squalls.				River frozen over.			
17												
18									Slight snow.			.3
19												
20	9 A. M. snow.	7 P. M.			4 A. M.				Snow in night.			3.5
21						6 P. M.		5.				
22												
23												
24												
25												
26					Snow Squalls.				Sprinkle of snow	in night.		
27												
28												
29												
30												
31									Fall of snow in the	night.		2.00
						Total,	.5	8		Total,	.50	6.55

GORHAM.—No report, except on the 6th inst., at 1 P. M.,—snowing.

RECORD OF RAIN AND SNOW.—NOVEMBER, 1870.

Day of Month.	MOUNT WASHINGTON.				LUNENBURG.				HANOVER.			
	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in gauge in inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in gauge in inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.
13						7 A. M.	1	2				
14					6 P. M.				Rain at 4:45 P. M.	Turns to a melting	.15	
15						2 A. M.	1-2	2		snow at night.		
16												
17									Slight aurora.			
18	Snowing,1 P.M.and	during night.			4 P. M.				4:30 P. M., Gentle	rain; snow in ev'g.		.06
19	12 1-2 " "	during night.				6 P. M.		8	Flurries of snow;	ground white.		
20												
21	Snowing 11 A. M.				Snow squalls.							
22	Snow and sleet du	ring night.							7 P. M.	10 P. M. Hails		
23	Sleet.				Shower.	4 A. M.	1-4			moderately.		
24	Sleet.											
25												
26									Rain in night and	early morning.	.24	
27	Sleet.											
28												
29	Snowing, 6 A. M.	8 P. M.			4 A. M.	2 P. M.			Rain during the	morning.	.10	
30												
						Amount,	1 3-4	12		Amount,	.49	.06

RECORD OF RAIN AND SNOW.—DECEMBER, 1870.

Day of Month.	MOUNT WASHINGTON.				LUNENBURG.				HANOVER.			
	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in Inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.
1												
2					8 A. M., slight snow	storm.			Conspicuous halo	around moon.		
3									Slight sprinkle of	rain during night.		
4									Very little snow.			
5												
6					9 A. M.	5 P. M.		.25	Gentle rain all day.		.10	
7												
8					10 A. M.	4 P. M.			Snow in early m'rn	ing and in the P. M.		.75
9												
10								.5	Little snow during	night.		
11									Drizzle at noon.			
12					11 A. M.				1:15 P. M. & 9 P.M.	rain-mist at dawn.	.22	
13						8 A. M.	.5	.25	Hail and rain in	night.	.18	
14	8 A. M. snow.,	6 P. M.			4 P. M.							
15						6 A. M.		2.	Slight snow in A.	M.—Aurora.		
16					Snow squalls.				River frozen over.			
17												
18									Slight snow.			.3
19												
20	9 A. M. snow.	7 P. M.			4 A. M.				Snow in night.			3.5
21						6 P. M.		5.				
22												
23												
24												
25												
26					Snow Squalls.				Sprinkle of snow	in night.		
27												
28												
29												
30												
31									Fall of snow in the	night.		2.00
						Total,	.5	8		Total,	.50	6.55

GORHAM.—No report, except on the 6th inst., at 1 P. M.,—snowing.

RECORD OF RAIN AND SNOW.—JANUARY, 1871.

Day of Month.	MOUNT WASHINGTON.				LUNENBURG.				HANOVER.			
	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage, inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage, inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage, inches.	Depth of Snow in in.
1												
2					6:30 A. M.	11 A. M.		2.	Snow in the night.			.1
3												
4									Slight sprinkle of	snow in the night.		
5					5 A. M.	6 P. M.		1.	Light snow in A. M.			.7
6	Sleet.											
7												
8												
9												
10												
11												
12	Sleet.											
13												
14												
15	Light rain.				10 P. M.				Rain in the night.		.06	
16						8 P. M.	1.5		Raining in morn	ing and dur'g day.	.39	
17					4 A. M	7 A. M.		1.	Slight fall of snow.			.4
18												
19												
20					10 P. M.							
21						10 A. M.		3.	Snow in night and	during the day.		.3
22												
23												
24	Snow all day.				11 A. M.	4 P. M.		1.	Snow in night and	during the day.		2.
25												
26	2 P. M. Snowing.				5 P. M.				1:30 P. M.			3.
27						4 P. M.		1.5	Snow during night			2.
28												
29					4 A. M.	2 P. M.		2.	Snow in night till	3 P. M.		3.5
30												
31					Showers.		.5					
						Total,	2.	11.5		Total,	.45	12.9

RECORD OF RAIN AND SNOW.—FEBRUARY, 1871.

Day of Month.	MOUNT WASHINGTON.				LUNENBURG.				HANOVER.			
	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.
1												
2					7 P. M., shower.							
3	9 P. M., snow.				4 P. M., snow.	12 M.		5.				
4												
5												
6												
7												
8	2 P. M., snow.				6 A. M.	4 P. M.		2.	10:30 A. M., snowing.			2.
9	Sleet.				5 P. M.	11 P. M., shower.			Sl't flurry of snow.			
10	Sleet.					5 A. M.		1.				
11									Beautiful Aurora at 8 P. M.			
12	2 P. M., snow.	12 M.			1 P. M.	9 P. M.		4.	10 A. M., snowing which continued more or less thro' the 13th.			
13												9.2
14	2 P. M., snow.	9 P. M.							1 P. M.			1.
15												
16					6 A. M.	5 P. M.		3.				
17												
18	Snow all night.				4 A. M.	12 M.	.5	1.	Shower, turned to hail and snow.	1:30 P. M. light rain	.17	6.
19												
20	Sleet.											
21									Aurora.			
22												
23												
24	Rain in the A. M.								Sprinkle.		.15	
25									6:30 A. M., mixture of rain hail & snow.			
26												
27	7 A. M., heavy rain.	9 A. M.			Snow squalls.							
28												
						Total,	.5	16.		Total,	.32	18.2

GORHAM.—8th, 9th, 10th and 11th, squally; 18th, snowing fast; 27th raining.

RECORD OF RAIN AND SNOW.—MARCH, 1871.

Day of Month.	MT. WASHINGTON.				LUNENBURG.				HANOVER.			
	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.
1	Sleet.								7 A. M., snowing.			.50
2												
3	6 A. M., rain.	5 P. M.			11 A. M.	6 P. M.	.50		10:20 A. M., rains	slightly all day.	.16	
4												
5												
6	7 A. M., snow.	2 P. M.			Snow squalls.				Rain in the A. M.		.15	
7												
8												
9												
10					Showers.		.25		11 A. M., rain.	2:30 P. M.	.20	
11												
12					Showers.		.50		7:15 A. M.		.12	
13									River broken up.			
14												
15												
16					2 P. M.	4 P. M.	.25		Hail in night, sl't	sprinkle of rain.		
17												
18												
19												
20												
21	Snowing all day.				2 A. M.	5 P. M.	1.50		6 A. M., raining;	hail in night.	1 36	
22									10: 30 A. M., very	light snow.		
23	9 A. M., snow all	day.			10 A. M.				Snow squalls.			
24						9 P. M.	.25	1.	Very light snow.			
25												
26												
27					5 P. M.	8 P. M.		3.	Commences snow	ing in night, snows [all day		6.
28												
29												
30												
31												
						Total,	3.25	4		Total,	1.99	6.50

RECORD OF RAIN AND SNOW.—APRIL, 1871.

Day of Month.	MOUNT WASHINGTON.				LUNENBURG.				HANOVER.			
	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage, inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage, inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage, inches.	Depth of Snow in in.
1												
2									Ground white with	snow at dawn.		
3	9 P. M. Snowing.				8 P. M.				2 P.M. Gentle rain.			
4	Snowing all day.								Rain during night.		.17	
5						11 A. M.	1.50	2				
6												
7												
8												
9												
10												
11	Snow, sleet	and rain.			5 P. M.				Rain in night. Lit	tle during day.		
12	6 A. M. Snow.					4 P. M.	1.50		Rain during night.		.58	
13	Snow during night			3								
14									Beautiful aurora	at night.		
15	11 A. M. Snow.											
16	Snowing all day.				6 A. M.				2 P. M. Gentle	shower.		
17	Snowing all day.					10 A. M.	.50	.25				
18												
19									9 P. M. Rain	begins.		
20	9 A. M. Raining.				12 M.	6 P. M.	.50		6 A. M. Rain.		.36	
21	8 P. M. Snowing.								Rain.		.12	
22	7 A. M. and 2 P. M.	Snowing.			Showers.		.25		Sprinkle of rain.			
23	Snowing.				Snow squalls.				Hail and wind.			
24												
25	Snowing.								Slight sprinkle of	rain.		
26												
27	Snowing.				Slight showers.				Rain during P. M.		.27	
28	Snowing.				4 P. M.	10 P. M.	.50		Rain during P. M.		.05	
29												
30	10 A. M. Snowing.				8 A. M.	2 P. M.	.75		7:20. Raining.		08	
						Total,	5.50	2.25		Total,	1.63	

RECORD OF RAIN AND SNOW.—MAY, 1871.

Day of Month.	MOUNT WASHINGTON.				LUNENBURG.				HANOVER.			
	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage, inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage, inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage, inches.	Depth of Snow in in.
1	1:30 P. M., snow.								9 P. M., raining.			
2												
3	7 A. M., sleet.								2 P. M., slight rain	and mist. 4 P. M.		
4	Snow all day.				8 A. M.				Heavy rain all day	and evening until		
5	Rain.					4 P. M.	1.50			2 P. M.	1.89	
6												
7	Snow.				4 A. M.	11 A. M.	.25		6 A. M., raining.		.21	
8	Sleet.				Snow squalls.	Frost.			2 P. M., slight rain.			
9					Frost.							
10	9 A. M., snow.											
11												
12												
13	9 P. M., snow.											
14	Snowing at times.				Frost.							
15												
16												
17									6:30 A. M., rain.			
18												
19												
20												
21	Shower in P. M.								9 P. M., rain.			
22	11:30 A. M. & 6 P. M.	Th'd'r Sh'w'rs.							10 A. M., thunder	shower and rain.	.03	
23												
24												
25												
26									6 A. M. Rain dur	ing night.	.08	
27												
28	8 & 9 A. M., snow.								Rain during day.		.04	
29												
30									Hard showers dur	ing day and night.	61	
31												
										Total,	2.86	

RECORD OF RAIN AND SNOW.—JUNE, 1871.

Day of Month.	MT. WASHINGTON.				HANOVER.			
	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.	Time of beginning of Rain and Snow.	Time of ending of Rain and Snow.	Rain or Melted Snow in guage in inches.	Depth of Snow in in.
1								
2								
3	4 P. M., rain.	6 P. M.						
4	10:25 A. M., rain.	11 A. M.			4:30 P. M., heavy shower.	5:15 P. M.	.65	
5								
6								
7					Slight fall of rain.		.05	
8	9 A. M., rain.	9 P. M.						
9								
10								
11	10 A. M., snow and rain.	4 P. M.						
12	9 A. M., snow and rain.	8 P. M.			6:45 A. M., raining.		.09	
13	11:30 A. M., snow and rain storm.				2 P. M., rain rest of day.		.21	
14	Snow, sleet.				Very light rain during night.			
15					Slight sprinkle.			
16								
17								
18	10 A. M., rain.				Rain all day.		1.08	
19	Rain.							
20					Very little rain.			
21								
22								
23								
24					11 A. M., raining.		.08	
25								
26								
27								
28					Rains quite hard in A. M.			
29	Rain at intervals.							
30								
						Total,	2.16	

OBSERVATIONS BY NATHANIEL NOYES.

In 1853 Nathaniel Noyes of Boston resided upon the mountain from the seventh of June to the sixteenth of September and took thermometrical observations at sunrise, noon and sunset each day. I give as a matter of interest the means,—for the last twenty-two days in June, 47°.5; for July, 48°.4; for August, 47°.6: for sixteen days in September, 44°.7.

REMARKS ON THE TABLES.

For the benefit of those who will study those tables critically, some of the particulars of the compilation should be stated. Every barometrical observation was first reduced to the freezing point, in accordance with Guyot's Tables, in "Miscellaneous Collections" of the Smithsonian Institution, Vol. 1. Next these figures were reduced to the level of the sea, in accordance with the formula on page 88 of the same tables. Every observation was not separately reduced by the formula, but the mean for the month was found and separately applied. Exceptions must be made in the case of the observations taken upon Mount Washington at 7:57 A. M., 4:57 P. M., and 10 P. M., after March first, as Sergeant Smith found the results more satisfactory to add the constant figure 6.293. The figures for the altitudes used were 6,291.7 feet for Mount Washington; 1,124 feet for Lunenburg; 800 feet for Gorham, and 603.710 feet for Hanover. The monthly means throughout the tables were taken by dividing the sums by the number of observations in accordance with the practice at the Shattuck Observatory. Ciphers in the columns of temperatures indicate zero of Fahrenheit; when dots are used they signify that no observation was recorded. The figures in the columns of "Force of the Wind" show its velocity in miles per hour, as given by Robinson's Anemometer. The common abbreviations for the technical names of the clouds are used: as cu. for cumulus, cir. for cirrus, and nim. for nimbus. Owing to the position of the observers, two sets of descriptions for the clouds were necessary—the first for those above the level, and the second for those below the level of the summit. In the column for the "Kind of Clouds," the abbreviation first given applies to the clouds above the observatory.

These tables will furnish the means of ascertaining meteorological facts of the greatest interest, as well as of practical importance. We have neither the time nor inclination to discuss them at length. At our request, Mr. Nelson, who has studied these observations with commendable zeal and success, has prepared a brief sketch of their bearings upon the predictions of the weather, and we take great pleasure in appending it to our report. His conclusions will commend themselves to every one who will take the pains to study the tables.

Respectfully submitted,

C. H. HITCHCOCK.

Hanover, N. H., July, 1871.

THE METEOROLOGY OF MOUNT WASHINGTON.

In this paper I propose to notice some of the meteorological phenomena observed here during the past year. A more extended inquiry than this would be well, but within the few pages assigned it is impossible to do more than briefly touch upon the several points which naturally present themselves in an investigation of this kind.

The advantages offered at Mount Washington, over stations at a less elevation, are many and worthy of consideration. It is an elevation of a mile above sea level; its considerable height over the surrounding peaks; the resultant clearness of so rarefied an atmosphere; in the summit being usually above the lower or surface currents of wind and cloud. As it is within the region of the higher upper currents, here are found barometeric, thermometric and hygrometric conditions unlike those of lower stations, and of value, in connection with them, in the forecasting of storms.

But this is not all: cloud-forms and storms may be most advantageously studied at all seasons of the year, every day, every hour in the day offering something new.

Although observations have been made in Europe similar to those made last winter under the direction of Professor Hitchcock, and since continued by the War Department, yet they have nowhere been so long maintained as here.

BAROMETER.

It is a well known fact that changes in the velocity of the wind and amount of cloud exercise a decided influence upon the barometer. These elements being strongly developed here, hence its sensitiveness and fluctuations as well as its wide range. From December to July the extremes were 22.120, to 24.104, corrected for temperature. The *daily* variation, as a rule, is fixed. It falls from 10 A. M. to 4 P. M., then rising to 10 P. M., when it falls again, reaching its lowest point at 4 A. M. On Mount Washington it has no fixed hours; the diurnal variation is governed, in a great measure, by the rate of the wind and amount of cloud. In calm, fair weather it is at the usual hours.

Towards the close of a gale, if for a few moments the wind rises after a lull, there is a corresponding fall of the barometer, but not to the minimum of the gale, a gradual rise is apparent until the maximum is reached.

There are times when the mercurial column is not at rest for a moment, and yet the range for an hour may not be more than .002 to .004 of an inch. The sensitiveness of the barometer may be best seen when clouds are passing over the summit.

Here it has a wide range during gales. Almost hourly observations were taken from 11 A. M., January 22d, to 9:30 A. M., of the 23d. This was one of the great storms. The range was 1.116. The observations from the 4th of February, at 7 A. M., to the 5th, at the same hour, gave a range of 1.403. There were many short gales in winter in which like results were obtained. On the 21st of May thunder showers prevailed over an extended area; none passed over the mountain or very near. The barometeric fluctuations were constant but slight. The 22d was also showery. On the summit, warm and calm in the morning, a tempest at noon and wintry at night. The temperature 66°— the highest at 11 A. M.— one of the finest mornings for the season. From early morning till noon the barometer fell rapidly, the range being 1.124.

The range of Mount Washington as compared with other places is wide. From December 1st to May 14th, it is for Mount Washington, 1.595, and for Hanover, 1.438.

Had we tables of hourly observations we might trace the movement of high and low pressure over the section of country included in the accompanying tables. There are, evidently, gales on the mountain which do not extend to the lower country, or if felt below are confined to the mountain region. These are of short duration though often violent.

But of the great atmospheric disturbances, covering one or more day's time, having a sweep of thousands of miles, we get, it would seem from the record of last winter's observations, the first barometeric indications below, at the lower stations. Preceding the gale of December 14th to the 16th, the maximum was obtained on the 11th at all these stations: Hanover, Gorham and Mount Washington at 2. P. M., and Lunenburg at 9. P. M. The minimum at Hanover and Lunenburg on the 14th, Gorham and Mount Washington on the 15th. But the high pressure obtained on Mount Washington the 20th while it did not at the other places until the 22d.

Before the gale of January 22d and 23d, the highest reading was on the 19th at each place, but it was some hours in advance of Mount Washington at Hanover and Lunenburg, 7 A. M., at Gorham, 2 P. M., and at Mount Washington, 4:57 P. M. At Lunenburg and at Hanover the lowest reading fell on the 21st; at Mount Washington the 22d. The maximum after the gale abated was attained at Hanover and Gorham the 25th; at Mount Washington and Lunenburg not until the 26th at 7 A. M.

An examination of the records show results much like these for each of the heavy storms during the winter; they likewise show that there are gales more severe, comparatively, at the lower stations attended by a falling barometer, when it is not unusally low on the mountain.

THERMOMETER.

Nothing is more certain than the fact that the rise and fall of temperature is first observed on the summit. The tables of thermograms for Montreal, Lunenburg, Vt., Providence, R. I., Hanover and Gorham in comparison with Mount Washington are full proof of this.

A low temperature accompanying the easterly movement of the high, cold, upper current of wind, is invariably from six to thirty-six hours earlier on Mount Washington than at Gorham even. Warm and cold waves occasionally drift over Mount Washington which do not descend lower. On the other hand a low temperature is registered at Lunenburg, on the 8th of January, when it was -18°, and only -6° at Mount Washington. It is noticeable that at Mount Washington the wind was south, at Lunenburg northeast.

As with the barometer so the thermometer has no fixed hour of the daily maximum and minimum. At Mount Washington there were seventeen days when the height was reached at 2 P. M., to ten at 7 A. M., and nine at 9 P. M., or when the readings were the same as at 2 P. M. At Montreal, twenty-nine at 2 P. M., to two at 7 A. M., and five at 9 P. M. Hanover, twenty-three at 2 P. M., to 4 each at 7 A. M., and 9 P. M.

Generally speaking, with clouds below the summit and a clear sky above, there is a rise in temperature at whatever hour of the day it may occur; with a dense cloud enveloping the summit a sudden fall is observed.

In winter the changes are very great; often in a half-hour, from 5° to 15° and at any period of the twenty-four hours. Instances are on record where temperatures differing thirty or forty degrees were noted in the course of the day.

HYGROMETER.

This instrument has been but little used in mountain observations heretofore, and there have been few records of relative humidity published. The *absolute* humidity of the atmosphere diminishes with elevation, but the rate of reduction is unknown. Early in the winter it was found that the report sent to Washington daily was of much value in making up the storm forecasts.

In relation to the observations made in this department I would call particular attention to the tables for Hanover and Mount Washington. Taking the winter and summer together we find that while the relative humidity of Hanover is greater in winter than Mount Washington, in summer it is much lower. Taking the tables for temperature and wind with that for relative humidity and the reason for the differences in the atmospheric conditions of the two places becomes plain.

The Hygrometer alone is a reliable instrument for foretelling the weather. On the monntain, with it we could assure ourselves as to the weather for that locality with almost a certainty. During the summer, tourists, stopping at the hotel, frequently availed themselves of the information thus gained, in making their arrangements for the ensuing day.

THE WINDS.

No one ever doubted that the summer winds at their worst had a velocity not equalled elsewhere, but no measurements had ever been made; the velocity of the winter winds were a matter for conjecture.

The record shows almost constant and exceedingly high rates. It shows too that the prevailing wind is a westerly one at all seasons. From the direction for the past ten months the inference is, that the summit is, as a rule, above the lower or surface winds. From June to September the easterly winds generally failed to reach the summit though frequently strong a short distance down the mountain.

Here, winds of from thirty to sixty miles per hour are the rule, light winds and calms the exception. In winter it rises to ninety and one hundred miles per hour; seldom in summer to ninety.

The winter gales spend their fury in a gentle north wind, often changing suddenly to south, which point it holds for many hours, or until another gale shall arise. A perfect calm is of the rarest occurrence in winter. The register exhibits very few single observations even. Comparing the other stations with this it will be seen that Lunenburg reports no calm for December, January or February. The wind was higher there than at Hanover. The altitude of Lunenburg gives climatic conditions approximating Mount Washington. At Hanover, for three months, there are recorded ninety-nine calms. In summer, winds of low rate and calms are more common on the mountain than in winter.

Easterly winds on Mount Washington are exceptional, out of two hundred and seventy observations, ten only were easterly. At Lunenburg seventy-three in the same time and Hanover forty-one. At Gorham out of one hundred and forty-seven there were forty-one. This average holds nearly as good for the summer months. Three or four hundred feet greater elevation would place the summit above the influence of the surface or lower winds. From the direction and thickness of the cloud the height of the wind may be at all times determined. The 23d of June, at 7 A. M., the cloud was unusually dense, the wind near the depot southeast, in puffs and calms, and nine miles per hour. On the roof of the hotel it was southwest, and fifteen miles, at least. An hour later the rain was pouring in torrents, and at the depot the wind had changed to southwest, thirteen miles per hour.

The records show that gentle westerly winds may prevail on the summit, while below, at stations near and remote, the wind is easterly and tempestuous. The record shows too that all the heavy gales of the winter were first felt on the mountain. Of one summer high wind—it was hardly a gale—there is a partial report. June 8th, at 5 P. M., a gale arose on the mountain, attaining its height at 1 A. M., the 9th. At Bethlehem there was a gentle breeze till 11 P. M., the 8th, from that hour till 5 A. M., 9th, it was rising. At Bethlehem a windy day followed, on the mountain it was moderate. Nor did it reach its highest point at Hanover untill it had abated on Mount Washington. It would appear that any great disturbance in the upper atmosphere may be reported from the summit some hours before any change is observed below, other than the barometrical changes.

CLOUDS.

It is obvious that the higher upper currents, especially of cirrus, which often floats at an elevation of 21,000 feet, will not present any very marked difference, at an altitude of a single mile. Generally it is during the transition stage into cirro-stratus or cirro-cumulus that we may find an advantage in even this elevation. It is quite a gain when we study the lower cloud-forms or watch the approaching storm. Here is an extent of country, in the field of view embracing nearly the whole of New England, eastern New York and southern Canada. As is well known the higher upper current of cirrus is a constant one from a westerly direction. Passing into any sub-form the course may be from all points between S. S. W. and N. N. W. The lower currents of cumuli and the stratus of winter run low, never rising, or seldom, to the level of the summit. The stratus of winter is often spread out over an area of several hundred square miles and yet it may not have an average thickness of 1000 feet. In the vicinity of the mountain it may have been at times not more than 500 feet and from that up to 3000. It is doubtful if it ever exceeds 3000 feet. In April there was the finest display of cumuli that we had for the entire season. It was many thousand feet in vertical thickness and miles in extent, the largest, the most massive body of cumulus I ever saw. We see the lower currents moving in different directions, both in winter and summer at the same time. Immediately round the mountains they follow the line of the several ranges if they are running low. It is not unusual at all seasons to see them have a S. E. course south of Mount Washington, and N. of Mount Adams a S. W. one at the same time. Condensation may be rapidly going on at one point, in a contrary one, but a few miles distant, the cloud is redissolving.

STORMS.

In observations on an approaching storm the elevation of 6,000 feet becomes important, inasmuch as the observer is above the lower strata—the "storm scud." Here he may note the changes in kind and relative position of the cloud from the moment it shows itself along the western horizon, two hundred miles away, till it shall envelope the lofty peak of Mount Washington.

When clear, the horizon of Mount Washington is a circle, having a diameter of at least three hundred miles. The elevation of a storm moving east can be seen as far distant as New York city.

Storms, when the condensation advances but little faster than the storm itself, are more interesting than are another class in which the condensation is going on for days, and over a great extent of country at one and the same time. When the condensation is rapid and with the storm, if it is from the south, we notice at an immense height the "polar bands" of cirrus, lower, cirro-stratus or cirro-cumulus. From the first until the storm breaks the progressive movement is traced on a north and south line,—west of that line is the storm,—east, fair weather; the upper current precedes somewhat the lower stratus or "scud." When the storm is within a hundred miles we see this more plainly. An under current of stratus—a condensation in advance of the storm is gradually spreading out on every side. Towards night the prominent landmarks are hidden from view, the cloud shuts down over the mountain. All about us an easterly storm is raging, here it is a south-westerly or westerly one.

A storm north is not so interesting, as it travels most rapidly along its southern edge. On the summit there are sometimes southeasterly storms. The great storm of October 4th, 1869, was from this direction and was very severe here as elsewhere. One short but severe gale of March last was a southeasterly one.

AURORA BOREALIS.

We witnessed many fine Auroras, but no new facts regarding them are on record. It is to be regretted that we were not prepared to observe to some extent, electrical phenomena, particularly in connection with auroral storms.

It rains at a temperature of 28° and more than once snowed furiously when it stood at 37°. Owing to the violence of the wind it is useless to attempt to measure the snow or rain. There is seldom more than two or three feet of snow to lie long.

Of the frost formation, very singular and very beautiful, there has been so much written that any lengthy remarks are unnecessary. Judged from its structure it seems to be identical with "hoar-frost."

Late in December a singular ice-formation was discovered. It never was alluded to in the papers. It may not be new but as I have never seen a description I will describe it.

It is transparent ice on the surface of the flat stones. Cellular in structure, the cells mainly hexagonal, some triangular and a few of an undefinable form. The cells averaged about .25 inches in depth by .15 to .20 inches in breadth. We saw it only once.

A "snow-flake" mentioned in the Press telegram of January 8th, as "new," may be described as pyramids of six sides, base depressed with sides corresponding to the exterior. It may not be new but it was only seen once.

The snow of the summit, until April, was often that of high Alpine regions, a dry, impalpable powder. Green snow was noticed once in February, it had but a slight greenish tinge scarcely perceptible.

S. A. NELSON.

REPORT

OF THE

GEOLOGICAL SURVEY

OF THE

STATE OF NEW HAMPSHIRE,

SHOWING ITS PROGRESS

DURING THE YEAR 1871.

BY

C. H. HITCHCOCK, PH. D.

STATE GEOLOGIST AND HALL PROFESSOR OF GEOLOGY AND MINERALOGY
IN DARTMOUTH COLLEGE.

NASHUA:
ORREN C. MOORE, STATE PRINTER.
1872.

STATE OF NEW HAMPSHIRE.

HOUSE OF REPRESENTATIVES, June Session, 1872.

ORDERED:

That the Clerk procure for the use of the House the usual number of printed copies of the Report of the Geological Survey of the State of New Hampshire.

Attest:

JAS. R. JACKSON, *Clerk.*

REPORT.

Hon. John H. Goodale, *Secretary of State:*—

Respected Sir:—I have the honor to present you herewith the Report of the operations of the Geological Survey during the year ending June 1, 1872. The full details, in accordance with the law establishing the Survey, are reserved for the final report.

The field operations were prosecuted vigorously during the whole of the summer season, chiefly in the more northern and southern portions, the former receiving the most attention. As the result, more information concerning the geological structure of the State has been acquired in the last summer's work than in all the previous seasons combined. As indicated in the last report, very diverse opinions respecting the age of the New Hampshire rocks have been entertained by the leading geologists of the country during the past thirty years. New interest has been given to the subject of New Hampshire Geology by allusions to it in the Presidential address of Dr. T. Sterry Hunt for 1871, before the American Association for the Advancement of Science—views which have called forth considerable opposition. It is believed that the key which shall unlock this mystery in Geology has been discovered the past season among our mountains.

The conclusions derived had been foreshadowed by our previous work, but they have been rendered much more satisfactory by the labors of the Survey in the Pemigewasset region, or the area lying between the Saco and Pemigewasset rivers and north of Sandwich. I do not need to add that all inferences concerning the kind and amount of valuable minerals likely to be found in our limits will depend upon the proper determination of the age of the formations, and on account of the practical results to be derived from our researches, attention has been directed primarily to the solution of this question. In order to promote the early settlement of their relative ages, I present herewith a preliminary Geological map of the White Mountains which will enable you readily to perceive what districts contain the formations of greatest interest.

DESCRIPTION OF THE MAP.

The colors upon the accompanying map show the geographical relations of ten groups, so far as they are known. In the absence of precise knowledge, spaces have been left uncolored in certain districts. The topographical basis is the map of C. H. V. Cavis, prepared for Eastman's White Mountain Guide, upon the scale of five miles to the inch, it being the most convenient and accessible to us. On account of the difficulties in the way of exploring among the mountains, which have been described in previous reports, this delineation can only be regarded as a reconnoissance, especially as the true position of the rocks did not suggest itself till late the present spring, when the field notes were being compared with specimens. The next season's work may afford more precise data to theorize upon. The areas will be briefly mentioned, and the most important conclusions dwelt upon at length.

1. *Porphyritic Gneiss.* This is an ordinary gneiss, carrying numerous crystals of orthoclase or potash-feldspar, from a quarter of one to two inches long. The longer axes may be parallel to the strike, or arranged helter-skelter. It passes into granite with the same porphyritic peculiarity of structure. Its most northern area lies along the Ammonoosuc River in Bethlehem, Littleton and Whitefield. Next, commencing west of Haystack Mountain, at some unknown point, is another range, which passes southerly on the west flank of Profile Mountain and makes up the great mass of Kinsman or Blue Mountain; thence passes southerly to Woodstock and Campton. It crops out on the west side of Moosilauk—how extensively has never been determined. A spur from this appears at the Lake of the Clouds on Mount Lafayette, and passes southerly towards the Basin. It may occupy part of the uncolored area west of the Lafayette range. Upon the other side of the Pemigewasset country, this formation shows itself in the valley of Sawyer's River and on the south flank of Mount Carrigain. It is there covered by the norian. It reappears in Waterville, on Cascade Brook, Snow's Mountain, Bald Knob, and upon other high mountains in Sandwich, whence it passes out of the

limits of the map. We suppose this to be the oldest formation among the mountains. Geologists speak of a rock of this character as common in the laurentian in various parts of North America and Europe.

2. *Bethlehem Gneiss.* The whole of Bethlehem is underlaid by a gneiss abounding in a talcoid mineral, perhaps pinite. The orthoclase is abundant, usually pink or flesh color, and mica is sparsely disseminated through the rock. It is usually granitic, so much so that it has always been called granite heretofore. Its most remarkable feature consists in the common east and west strike between Littleton and Cherry Mountain. In Whitefield, Mr. Huntington finds the rock tending more northeasterly. Lying between outcrops of porphyritic gneiss the natural inference is that it is a synclical and therefore newer, while the strike indicates a very great antiquity judging from the same phenomenon elsewhere. The dip is monoclinal, averaging 75° northerly, across Bethlehem, but anticlinal in Whitefield. If the anticlinal structure is persistent, evidence may be afforded that this peculiar gneiss is older than No. 1. There is a limited outlier of this rock west of Haystack Mountain, another northwest of Mount Pemigewasset, a third about Big Coolidge Mountain in Franconia, and perhaps another south of the East Branch of the Pemigewasset. These limited outliers give the idea of a rock newer than number one. The boulders scattered to the north of Lafayette in Franconia and Bethlehem, which Professor Agassiz regards as moraines of a local glacier pushing northerly, are composed of this rock.

3. *Gneiss.* The gneiss west of number one in Franconia and Landaff, and also to a limited extent east of the Norian on Tripyramid, is a common variety, and has not yet been referred to any of the sub-divisions recognized elsewhere.

4. *White Mountain or Andalusite Gneiss.* This is the variety described in previous reports as containing andalusite or staurolite. It occupies the great part of the White Mountain area east of the Saco, making up the bulk of the highest peaks. It reappears on equally extended a scale south of Mounts Kiarsarge, Chocorua and Whiteface. About Dr. Bemis's residence, or the "Mount Crawford House" of the map, this rock seems to be isolated, being surrounded by granite. A little of it lies to the north of the norian in Albany, and is not represented upon the map. Further north it crops out in Whitefield, and there is a range ap-

parently from the west flank of Profile Mountain to Moosilauk. More is found in Thornton, and there is an extensive area of it to the southwest which is not designated upon the map. The presumption is that the beryl-bearing gneiss east of the Pemigewasset on the edge of Woodstock and Thornton is the same rock, extending into Campton. The amount of andalusite in this area is very small. The relative position of the andalusite gneiss remains to be determined. It seems to be newer than Nos. 1 and 2, but the relations to the granites and norian are yet to be made out.

5. *Common Granite.* The type of this rock appears at the Basin, Pool and Flume in Franconia, and at Goodrich's Falls in Jackson. The constituents are rather coarse, never more than an inch and usually one fourth of an inch long. The orthoclase is commonly flesh-colored and the most abundant ingredient. The quartz is smoky, translucent, and often roughly crystalized. The mica is the least abundant of the three constituents, and is black. The joints passing through this rock are both horizontal and vertical. This rock seems to form the basis of the whole Pemigewasset country and the areas left blank will most likely be found to consist of this same material. The first area is that in Franconia, embracing the Profile and Cannon Mountains besides the parts already specified. The mountains show a finer-grained rock than the valleys. Some of it seems to extend into the uncolored area between No. 1 and the Lafayette range. This probably connects under Flume Mountain with the granites on the East Branch in Lincoln and Thornton. More appears near the forks of the East Branch, Hancock Mountain and the ridge north, including the "Falls," in the valley of Mad River in Waterville, abundantly in the Swift River Valley in Albany, and about Conway, passing under Kiarsarge and extending into the Green Hills. The small area of Bald Face and Mount Eastman in Chatham has a fine grain and possibly is of a different age.

The largest area of this rock upon the map extends from Jackson to Carroll. The Saco valley above Rocky Branch is mostly excavated out of it. The excavation of the White Mountain Notch out of this granite was alluded to last year. The high range north from Mount Lowell to Mount Willard is probably of this rock. East of the Saco the andalusite gneiss seems to have been cut by it, Mounts Crawford and Resolution being composed of granite. Mount Deception and the country east of the old Fabyan House is made up of a different sort of a granite, whitish or grayish in color, with the feldspar in narrow crystals, porphyritic in appearance. But the range from the north end of Mount Tom to the Lower Falls on the Ammonoosuc, and the three "Sugar Loaves" farther west, are entirely of the typical variety of coarse granite.

6. *Trachytic Granite.* Above No. 5, with the same horizontal appearance, is a granite of trachytic or semi-porphyritic aspect. The feldspar is orthoclase, as shown by Analysis XI., and most of the rock is made of it as rounded crystals imbedded in a granitic paste, with scarcely any quartz. Feldspar and a dark mica may be discerned. It often contains a small per cent. of manganese. The first great expanse of this rock lies between the sawmill of Rounsevel and Coburn, in Carroll, on the Ammonoosuc, and Waterville. The Twin Mountains, Haystack, a portion of the Lafayette range beneath the cap, Mounts Liberty, Osceola, and other high peaks, are mainly composed of this trachytic granite. It will be observed that this area is wholly in the forest region, untraversed by roads; hence it is not strange that its peculiar characters should not have been recognized earlier. There is some of this rock north of Mount Carrigain, and the Sawyer's Rock range appears to belong here. Other localities are high up Rocky Branch in Bartlett, Iron Mountain, the valley of the Saco in Bartlett, underlying the great mass of Kiarsarge, but above the common granite. The rock referred to this division, along the Swift River and the Ossipee mountains, is made of finer materials, with more of the paste, and that of a darker color than the ledges further west. It also disintegrates less readily.

7. ***Brecciated Granite.*** This designation applies to brecciated masses, often of large fragments, in Franconia, forming Eagle Cliff, and several nameless peaks between Profile and Kinsman. The fragments most easily recognized are those of porphyitic gneiss, dark gneiss and hornblende, imbedded in a very compact feldspathic paste. Along Eagle Cliff there are appearances of stratification, and at Echo Lake the brecciated granite appears to underlie the porphyritic gneiss. The rock is irregular in arrangement as if thrust up from below. As it contains no fragment of the common and trachytic granite, we have concluded it to be more ancient than either of these granites, but newer than the porphyritic gneiss. The two areas are also probably connected

beneath the Pemigewasset valley under the common coarse granite, which either flowed in above the breccia or was deposited upon it quietly in some other way.

8. *Norian.* This includes several areas of labradorite rock, including compact felsites, breccias and syenites. They are the Lafayette range, Twin Mountain area, near Loon Pond, Tripyramid region, Carrigain district, north of Mount Tom, Valley of Dry river, Valley of Rocky Branch, Sable Mountain in Jackson, Mount Kiarsarge or Pequawket, Deer river valley of Albany, near Mount Chocorua, and Red Hill, Moultonboro'. There are other areas to be referred to the same group outside of the White Mountain area. These rocks are elsewhere described in as much detail as is best.

9. *Clay, Slate and Quartzites.* The first of these areas is a limited one on the south slope of Kiarsarge; the second southwest of Mount Willard, passing into andalusite slates and quartzites on Mounts Willey, Lincoln and Tom.

10. *Coos Group.* This embraces the andalusite slates on the east flank of the Mount Washington range, repeated on the north east side of Camel's Hump near Gorham, and the staurolite rocks from Littleton southwards, curving around the underlying Bethlehem gneiss. Only the eastern border of the latter is indicated upon the map.

NORITE ROCKS.

Our conclusions as to the absolute and relative ages of the New Hampshire formations depend upon the reference of some of them to the Norian system of Hunt. As this term is doubtless entirely new to you, I may be excused for referring to the reasons which call it forth.

The older geologists regarded all the crystalline rocks as those first formed or "primary." The granites were considered as remains of the original crust, cooled down from the condition of intense fusion, and the gneiss, mica schists, etc., resulted from the action of eroding agencies, tearing off fragments of the granites and depositing them in the lower areas. These unstratified and stratified rocks have also been styled *Azoic*, from the supposed absence of life in these early periods. Only lithological names had been applied to the different Azoic rocks till 1855* when Sir W. E. Logan proposed that the Azoic formations in Canada beneath the Potsdam sandstone should receive local appellations, and he accordingly separated them into two groups, calling the older *Laurentian* and the newer *Huronian.* These terms expressly excluded the Azoic rocks of New England which by many authors had already been considered to be of Paleozoic age. So early as 1845 Logan perceived that the gneiss of Canada, afterwards termed laurentian, could be divided into two groups, dependent upon the presence or absence of beds of limestone, and in 1857* suggested that such a subdivision would probably be found desirable. The studies of Dr. Hunt from 1852 onwards upon the feldspars led him also to suspect the truth of this classification of the laurentian, the lime-feldspars being assigned to another group than that carrying the limestones. In the report upon the Geology of Canada for 1863,† great vertical thicknesses of the laurentian gneiss are distinguished mineralogically from the others by the presence of triclinic-feldspars, and the rocks termed *anorthosites.* Later in the same volume certain facts are stated rendering it probable that the anothrosite series unconformably overlies the gneiss having beds of limestone in it.‡ The formal proposal of this subdivision is presented in the atlas accompanying this report issued in 1865, where the anorthosite group is distinguished as the *Upper Laurentian* or *Labrador* series, and the other the Lower Laurentian. The nomenclature of this atlas is based upon further exploration. Had this not been satisfactory the distinction in the atlas would not have been delineated. The evidences of unconformity consist in the concealment of beds of limestone by the upper rocks covering them and the change of strike. The testimony of Mr. James Richardson to the relations of the Lower and Upper Laurentian on the north shore of the St. Lawrence in 1869 confirms the reality of the division. He represents the dip of the laurentian to be nearly vertical with a north and south strike, while the labradorite rocks dip at comparatively moderate angles with a strike nearly east and west.§ This separation of the laurentian into two systems has not been observed in other countries, or by other surveys than the Canadian, and hence geologists are not yet all satisfied with the correctness of the conclusions. But all will agree that the mineral labradorite belongs to the original laurentian system, and therefore by its discovery in New Hampshire, will be satisfied that some of our crystalline rocks belong to the older series of the Eozoic, and not the Paleozoic. Hence the prevalent opinion respecting the age of the New England metamorphic rocks must be changed to conform with the discovery of labradorite in our state. The various opinions respecting the age of the White Mountains were alluded to last year.

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* Esquisse Geologique du Canada.

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*Proc. Amer. Asso. Adv. Sci., Vol. XI, p. 47.

† p. 22, 33, 478, 586. ‡ p. 839.

§ Geol. Survey of Canada, Report 1866-9, p. 306.

Dr. Hunt in 1870 recalled the fact that the term Norite had been applied to rocks containing the lime feldspars before Labradorite; and therefore proposed the term *Norian* (from Norway) to take the place of Labradorian for the system. He calls attention to those rocks in a paper before the American Association for the Advancement of Science in 1869, which was reprinted in the "American Journal of Science." The system, if it be a system, is yet to be explored carefully; for we do not know its thickness, the various schists which naturally compose it, nor its proper relations to the Huronian. We may hope that the Pemigewasset country will hereafter afford some of these greatly to be desired details.

As our conclusions are based upon the existence of labradorite in our limits, it may be best to describe its principal localities.

LABRADORITE IN WATERVILLE.

Near the east line of the town of Waterville is a high mountain, called "Tripyramid," for the reason that from an oval base three conical peaks rise to nearly the same height, the highest being 4086 feet (Guyot) above mean tide water. The course of these summits is ten or fifteen degrees west of north. From Chocorua and Kiarsarge Mountains the northern cone is farther away from the middle than the southern one, and there are two subordinate elevations each side of the centre. Bond gives four peaks on his map corresponding to Tripyramid, the two southern 4400 feet each, the others 4300 and 4000 feet above the sea. The whole mountain mass is isolated and is therefore quite prominent. The southern peak is about three miles westerly from Passaconaway in Albany, and four from Whiteface in Sandwich, both of nearly the same altitude; while Osceola, on the boundary line between Waterville and Allen's Grants, is 4397 feet above the ocean, and not less than six miles away. The Grafton county map improperly calls Tripyramid Passaconaway, and misled by this authority many persons have fallen into error in their descriptions of localities.

The notable storm ending Oct. 4, 1869, gave rise to a remarkable freshet upon the southwestern slope of the most southern of these pyramids. The mountain side seems to have been covered by spruces growing above loose blocks carpeted abundantly with moss, very much as is common all over the White Hills wherever the climate permits temperate vegetation to flourish. No valley furrowed the slope, and it seems difficult to understand why the waters should have accumulated so enormously at this point, and nowhere else in the neighborhood if we may judge by the effect produced; especially since the bare mountain side exposed at this time has rendered the area conspicuous as a landmark fifty miles away. It were easy to imagine that some atmospheric disturbances had collected the waters for a circle having a diameter of a mile, and discharged them in a narrow stream upon the forest beneath. Clouds are sometimes said to "burst" when their contents are poured very quickly into some limited area, most usually when a tornado or rapidly formed nimbus flits by, yet something of a similar character will best explain the phenomena displayed in Waterville during this never-to-be-forgotten storm.

Almost immediately after the storm this locality was visited by Prof. G. H. Perkins, Ph.D. of the University of Vermont, Rev. M. T. Runnells of Sanbornton, and Charles Cutter of Campton. Prof. Perkins wrote a description of the changes wrought in the country and published it in the "American Journal of Science" (II. Vol. XLIX., p. 158). As he made careful estimates of distances in the upper part of the mountain, I will use his figures in the paragraph that follows.

The sliding commenced about forty rods from the summit, a little one side of the highest point. The beginning of the bare earth is only a rod in width. The breadth increases gradually for fifty or sixty rods. For the following seventy rods down hill it widens rapidly, attaining at one hundred and thirty rods distance a width of twenty-five or thirty rods. Thirty-six rods lower the breadth is seventeen rods. The course is nearly straight to this point—one hundred and sixty-six rods, where it begins to curve towards the northwest instead of continuing southwesterly, and eighty rods below is what Prof. Perkins regarded as a termination of the slide. The waters excavated a gorge through the boulder-clay or "hardpan" of the country after passing the elbow, often twenty-five feet deep, the material being almost as firm as solid rock. The whole course thus far mentioned is two hundred and forty-six rods, of a general fusiform outline with the lower end curved to one side. The inclination of the debris is often as much as forty-five degrees, perhaps higher for a dozen yards, and generally somewhat less. The underlying ledges appear in two or three places, but do not exhibit any marks or scratches made by the sliding mass.

The curve of the bottom of the hill is nearly a right angle and was determined by the configuration of the land, for directly in the way of the slip there is a low ridge covered by a forest. Were the phenomenon a true slide the materials must have been arrested by this obstacle. But no more earth lies before this obstruction than along any part of the two or three miles distance of the steepest descent below. The forest must therefore have been torn up by a prodigious freshet, trees, earth and rock fragments mingling with the water as if all a liquid mass, winding through the curved valley of a stream and excavating a deeper channel below the turn in its direction. In a clearing of fifty acres at the base of the mountain, called "Beckytown," great piles of rubbish, rocks and trees accumulated, while only earth was transported farther.

For nearly two miles below the elbow mentioned above the current descended rapidly, occasionally depositing gravel in protected nooks, which with their sloping surfaces may be called terraces. Quite high up is an interesting excavation in the form of a notch, where one side is long, sloping gradually, and the other steep and short. Half way down the stream — which may appropriately be termed Norway Brook on account of the name of the formations traversed by it — the water falls precipitately over a ledge of the dark norite rock. Elsewhere the valley is like that of any mountain torrent.

This locality is easily accessible. During the summer a stage runs from Plymouth to Greely's Hotel in Waterville, a distance of twenty miles. From this summer resort the first of the norite ledges is less than two miles, over a well defined footpath, and passing near a picturesque cataract. Mr. Greely can direct visitors to these rocks.

The locality was first visited in a scientific way by Dr. Perkins in 1869, who did not recognize the Labrador feldspar. In May, 1870, Mr. J. H. Huntington went up the stream, bringing back specimens of the dark rock which he suspected might be labradorite.

He carried a fragment of it to Dr. T. Sterry Hunt of Montreal, for examination. Dr. Hunt's analysis showed the predominant mineral to be labradorite, in a letter dated March 21st, 1871, and addressed to Mr. Huntington. Not being aware of the existence of this letter, I quoted from another letter of Dr. Hunt's, addressed to myself, and written about the same time, the following sentence, which was printed in a brief communication concerning the "Norian rocks in New Hampshire" in the January number of the "American Journal of Science," 1872. "The specimen brought by Mr. Huntington is a labradorite or norite rock, which resembles in composition and aspect that of the labradorian; with this difference, however, that it is much more tender and friable, and in this respect resembles the granitic gneiss of the White Mountains, as compared with similar rocks in the Adirondacks." I regret exceedingly not to have been made acquainted with the other letter, and therefore am very glad to furnish the following from Dr. Hunt of a later date, in which he directs attention to the omission of his analysis, and mentions other points of interest respecting the minerals.

MY DEAR PROF. HITCHCOCK:—In your note in the "American Journal of Science" for Jan. 1872, (p. 44) on the presence of labradorite rocks in New Hampshire, you quote from a letter of mine to Mr. J. H. Huntington, dated March 21, 1871, in which I pointed out that the rock from Waterville was a labradorite or norite; and you subsequently refer to the analysis of Mr. E. S. Dana in the same number of the Journal, as confirming my opinion, and as showing that the rock consists essentially of a feldspar allied to labradorite, together with a portion of titaniferous magnetic iron, and grains of chrysolite.

A further reference to my letter above noticed, would have shown that I had already analyzed the rock, and examined the associated iron ore. I there wrote as follows: "The blue granular crystalline rock from Waterville, N. H., consists chiefly of a feldspar allied to labradorite. I have not separated the grains to get them quite pure, but the mass is seen under a glass to consist of the bluish-grey cleavable-feldspar, with some mica, probably biotite, and a little magnetic iron ore. From a pulverized sample the magnet takes up about 5 per ct. of magnetic grains; these contain a little titanium. The analysis of the material thus freed from the magnetic portion gave me: silica, 50.30; alumina, 25.10; protoxide of iron, 4.23; lime, 14.07; magnesia, 2.95; volatile, 0.70: loss (alkalies) 2.65—100.00. I have found the feldspar of the so-called labradorite or norite rocks very variable in composition, being sometimes more and other times less basic than typical labradorite." "The analysis agrees closely with what might be expected from an admixture of labradorite with biotite. It (the rock) may hold a little hornblende, but I did not discern any. Thus the rock agrees chemically and mineralogically with much of the norite of the labradorite series of rocks, in which titaniferous iron and biotite not unfrequently occur."

I did not observe any chrysolite in the specimen examined by me, nor, on the other hand, did Mr. Dana find any biotite, showing some little variety in the norite, from this locality. He remarks that a rock consisting of labrador with chrysolite (olivine) has not been previously described. It was however long since noticed by McCulloch, in Skye, and by G. Rose at Elfdalen. [Senft *die Felsarten;* also Geology of Canada, p. 650.]

I may here mention that with the great masses of titaniferous iron ore found in the Black Hills in Colorado, there occurs a very characteristic coarsely-granitoid lavender blue norite; specimens of which were brought me last year by Prof. Richards of the Massachusetts Institute of Technology.

Yours very faithfully,

T. Sterry Hunt.

Montreal, May 1st, 1872.

The substance of this note having been communicated to Mr. Dana, the following letter came from his father.

Prof. C. H. Hitchcock. *My Dear Sir:*—In the absence of my son, Mr. Edward S. Dana, now on his way to Europe, I write a brief reply to your letter of the 29th inst. You stated that Prof. T. Sterry Hunt, in a recent note, objects to Mr. Dana's remark that a rock of the composition of the ossipyte of Waterville had not before been described, and that he refers to Macculloch as having observed the same in Skye, and G. Rose, another example of it at Elfdalen in Sweden. Mr. Hunt is evidently unaware of the facts. Macculloch found chrysolite in Skye, according to his two articles in Vol. III. and IV. of the Transactions of the Geological Society of London, only in trap or "amygdaloid;" and he repeats the same essentially in his work on rocks, the chrysolite being spoken of as occurring in an eruptive or overlying rock. Greg and Lettsom, in their work on BritishMineralogy (1858), confirm this by speaking of the chrysolite of Skye as being found in *trap*. Moreover the chrysolite is one of three constituents; the other two being hornblende or augite, and a feldspar; and the rock is not laurentian or norian.

The rock of Elfdalen is undoubtedly related to that of Waterville, and yet is widely different. I have not seen Rose's description of it. But Senft, to whom Mr. Hunt refers, speaks of it as a hypersthene rock, that is, a granular compound of labradorite and hypersthene, with grains of chrysolite as an accessory ingredient. The ossipyte, on the contrary, consists almost solely of labradorite and chrysolite, there being "only a very little of a black mineral, probably hornblende." I examined the specimens of ossipyte with Mr. Dana, the same that I collected when in Waterville with you, and through much of it could detect no hornblende whatever. Mr. Dana was right, therefore, in saying that this Waterville rock, consisting essentially of labradorite and chrysolite, is one not previously described. The principal constituent, besides the two mentioned, was the titaniferous iron one, which he found distributed in microscopic grains through the labradorite.

The light colored rock from a point higher up the stream, determined to be

a Labradorite rock by Mr. Dana, is, as he observes, wholly different from the ossipyte, it containing much hornblende and no chrysolite, and the titaniferous iron ore in visible grains instead of invisible particles disseminated through the labradorite.

The analysis of the Waterville labradorite, by Mr. Hunt, of which you send a copy, takes no note of the fact that the mineral is full of disseminated grains of titaniferous iron ore, as above remarked. The presence of this mineral may in part account for the large percentage of iron obtained in his analysis.

Yours truly,

JAMES D. DANA.

I first visited the locality August 18 and 19, 1871, and subsequently on Sept. 20, in company with Prof. J. D. Dana. As already intimated, I furnished a short article, descriptive chiefly of this locality, for the "American Journal of Science," January, 1872, and Mr. E. S. Dana followed with analyses of the feldspar and chrysolite, the specimens having been obtained by his father on the twentieth of September. The discoveries made since that time will be noticed presently.

In ascending from Beckytown, the first rock seen was called gneiss with nodular orthoclase, with its supposed strata dipping by compass 80° S. 70° W. This rock is evidently the same with the "Trachytic granite" of Mount Osceola and elsewhere. After noticing its distribution in mass throughout so large a portion of the Mountains, and its nearly horizontal position between the coarse granite below and the felsites above, the presumption arises that these so-called strata may be bands of mica whose planes do not correspond with those of accumulation, but have been superinduced during the metamorphism of the rock. The jointed planes dipping about 25° westerly would be those of stratification, if the rock is stratified. These were pointed out by J. P. Lesley.*

A few rods up Norway Brook appears the first ledge of the Ossipyte. Its junction with the gneiss is concealed by drift. For about a mile similar ledges occur, some exposures being sixty or seventy feet long. Considered as an isolated case it is difficult to determine the planes of stratification since two prominent sets of jointed planes exist, either of which might be taken for strata. One set dip about 20° northerly, and are the most numerous. The other dip about 75° W. 10° S. As the latter correspond better in position with the supposed strata of nodular gneiss, it was thought they indicated the proper lines of deposition. The former, however, are what appear at the first glance to be the strata, and as by this interpretation the position of the rocks at Waterville will correspond with that in Franconia about the Lafayette range, our former ideas must be modified. We should have therefore an underlying granite as seen in Mad River two miles below Greely's Hotel, then the trachytic granite of Osceola, extending to the cascades and including the "nodular gneiss" on Norway brook, dipping gently westerly, and finally above both the ossipyte schists, with a small inclination. Analyses I., III. and XIII., are of minerals from the norite bands.

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*Proc. Amer. Acad. Sci., Philadelphia, 1860, p. 363.

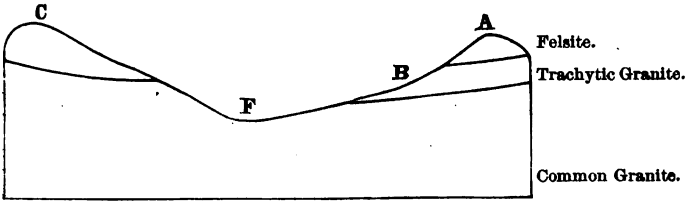
The ossipyte is abruptly succeeded by the gray rock called syenitic, being sometimes labradorite with hornblende and some mica, then orthoclase, labradorite and mica with scarcely any hornblende. The line of junction is irregular, averaging the course N. 20° E, while the dip of the plane of separation is about 85° westerly. Some of this feldspathic rock has been injected into irregular cavities of the norite. The general impression is that the syenite was an eruptive rock, cutting nearly vertically across the norite.

Perhaps an eighth of a mile above this junction the interesting assemblage of coarse crystals of whitish labradorite, hornblende, titanic iron, mica and epidote (see Analysis II.) occurs at the "Notch." These ledges disintegrate very rapidly. Large nodules of the syenitic rock less liable to decomposition are scattered through the mass; and there are geodic cavities containing orthoclase, albite, quartz, and rarely stilbite. The "Notch" is produced by the erosion of a ferruginous band, resembling a stratum, and dipping both E. 15° S. and E. 35° N. Above the notch, as far as the "Elbow," there is a recurrence of the finer-grained syenite, containing geodes and feldspathic veins. At the Elbow there is a somewhat different mineral combination, extending to the top of the Pyramid. Quartz is rare, but there are two kinds of feldspar. Mica is abundant and some specimens show hornblende. The same minerals occur in the geodic masses as below, also actinolite, amethyst, and others yet undetermined. Analyses IV. and XII. show the composition of one of these feldspars—being suggestive of Andesite.

The area colored as norian upon the map includes the ossipyte and various syenitic rocks about the whole of Tripyramid. Upon the north-east side Mr. Huntington found a similar order of ledges in ascending that tributary of Swift River called Sabba Day brook. Near the mouth of the stream there is a cataract falling over the common granite of the country. The same appears a mile higher up. The same rock is found on Downs's Brook, another tributary of Swift River, running very nearly along the line between Waterville and Albany. The trachytic granite was not observed here, possibly because we had not learned the importance of distinguishing it at the time of the visit. But higher up Sabba Day brook Mr. Huntington found compact labradorite in place apparently devoid of chrysolite, and fragments whose cleavable crystals displayed the play of colors usually seen in this species. Higher up the mountain, the north Tripyramid, the syenitic rocks of the slide reappear. Farther south the labradorite passes into a breccia apparently overlying gneiss. The rocks adjacent to this norian area are the trachytic granite at the base of Tripyramid on Norway brook, and probably on the north, since specimens of it have been brought from the Flume upon Flume brook, nearly two miles distant; common granite to the northeast, gneiss on the east and porphyritic gneiss upon the south. Concerning the latter an additional word of explanation can be given. There is a low ridge between Norway and Cascade brooks, the latter being about a mile distant from the former and essentially parallel to it. First we see the trachytic granite at the "Cascades," whose position is essentially like that just below the ossipyte. Above that for a mile's distance or more, I followed up the stream over ledges of porphyritic gneiss, much disturbed, but with the dip of 75° N. 20° E. most common. The hill between the streams was not examined, but if the position of the ossipyte remains uniform, it must be underlaid uncomformably by the porphyritic gneiss. This latter rock is very extensive. The ledges upon Cascade brook seem to be the northern end of continuous exposures all the way from Fitzwilliam, if not from southern Massachusetts, a distance of ninety miles, and sometimes a breadth of fifteen.

THE LAFAYETTE RANGE.

From a peak north of Mount Lafayette in Franconia to Flume Mountain there seems to be a nearly continuous band of dark, compact feldspar, about five miles long, and never more than two hundred to three hundred feet thick. It closely resembles some of the compact labradorites (see Analysis XVI). The layers are horizontal or slightly inclined to any point of the compass, resting upon trachytic granite throughout. It has not actually been traversed from the south end of the Lafayette ridge to Flume Mountain, but the topographical features of the country are such as to render probable its continuance by a curve to connect with that which has been observed upon the latter summit. The annexed wood-cut will show the relative position and thickness of the rocks between Mount Liberty (C), and Mount Flume (A), two thousand two hundred and fifty feet above the bottom of the valley. There is the common coarse granite at the base, the celebrated Flume of Lincoln (Franconia), lying at the bottom of the valley, (F in the figure) eighteen hundred and forty-nine feet above the ocean. Above the Pemigewasset river there may be six hundred feet thickness of this rock, considering it to lie horizontally, before reaching the trachytic variety. This in turn may be one thousand feet thick. This rock caps Mount Liberty, but the compact feldspar has been spared by the denuding agencies upon Mount Flume. As seen by the general map the edges of this dark rock everywhere rest upon the trachytic granite.



OTHER LOCALITIES.

There seems to be an extensive mass of this dark rock associated with a red felsite east of Franconia Branch. The latter rock was at first thought to be jasper, but its analysis shows it to be orthoclase. The dark variety is the same with that analysed by Prof. Seeley (VII.), the label being "a boulder from Waterville." One of the red boulders from the same locality, (Analysis XV.) seems to be the same rock with that in place in Albany (Analysis XIV). The analyses show that these felsites are related to orthoclase more nearly than to any other feldspars. The iron is more abundant than usual in both kinds. The comparatively large amount of lime and magnesia is worthy of consideration, and may be explained by its nearness to labradorite stratigraphically. Both overlie the trachytic granite and would seem to belong to the same formation, be it norian or laurentian. The Berlin felsite (VIII.) corresponds well with the others so far as the constituents have been determined. This comes from a different horizon, from a hornblende gneiss north of the White Mountains.

The felsite near Loon Pond in Woodstock is like that capping Lafayette. It is very limited in extent, and does not rise so high topographically as the trachytic granite to the east. Mount Carrigain is largely composed of felsite, often porphyritic, apparently orthoclase, judging without analysis. This is an isolated peak, four thousand six hundred and seventy-eight feet high, with trachytic granite joining the felsites on the north, the White Mountain gneiss on the east, porphyritic gneiss on the south, common granite on the west. Ascending the east spur from Carrigain brook one finds the strata dipping first northerly and then southerly towards the centre of the peak. Descending towards the headwaters of Sawyer's River on the southwest side of the east spur, the strata have been much distorted and faulted, highly inclined and nearly horizontal layers nearly touching each other. The rock on the highest peaks is different, evidently approaching the trachytic granite in character. So much fine dark mineral is present as to produce a grey color when weathered. The adjacent ledges would indicate that the Carrigain rocks are allied to the compact felsites of Lafayette, etc., in position.

A trip northward from Mount Tom, west of the Crawford House, resulted in the discovery of compact labradorite. Another excursion in 1870, along the Dry or Mount Washington River, east of the Saco, led to a similar discovery (Analysis XVII). The specimens were laid aside and forgotten till the discovery of the Waterville labradorite called attention to them. The same was true of specimens from Rocky Branch, most of which are of a coarse breccia. The first are situated in the midst of the White Mountain gneiss, less than five miles from the summit of Mount Washington. The study of this locality will certainly throw light upon the age of the schists, if the occurrence of the lime feldspar is indicative of geological age.

Two groups of strata occur at Sable Mountain in Jackson. Most of the area is a coarse breccia, and that on the west side appears like a compact labradorite. They are encircled by the White Mountain schists. Some of the rock at the tin mine resembles the syenitic rocks of Tripyramid. Mount Pequawket or Kiarsarge shows a feldspathic rock in its upper portions which seem to overlie a trachytic and common granite, and therefore to have the same stratigraphical position with the felsites above enumerated. Upon Deer River in Albany an interesting series of specimens has been obtained by Mr. Huntington. At Swift River and for half a mile north is found the modified trachytic granite, mostly orthoclase. Next appears a gray conglomerate of very small pebbles, containing also crystals of feldspar. Boulders of a similar rock were collected at Waterville. North of this comes dark felsites like those from Pemigewasset (Analysis VII.), breccias and trappean rocks verging into porphyry. Next is a coarse breccia composed of light and dark orthoclase felsites and fragments of labradorite, judging by the eye. Then succeed red compact felsites (Analysis XIV). Mr. Huntington traveled one or two hundred rods above these feldspathic rocks, and found only a schist resembling the White Mountain gneiss to the north. Between this point and the Saco Valley in Bartlett is a high mountain range which has not yet been explored. The rocks along the Saco are common granite. Mr. Huntington has also found an abundance of what seems to be labradorite upon Mount Chocorua, in the southeast part of Albany.

Red Hill in Moultonboro' and Sandwich is composed of a syenitic rock so similar to that associated with norite as to suggest a corresponding position. The syenitic area is elliptical, say three and a half miles long by one and a half wide, the eastern summit being seventeen hundred and sixty-nine and the western two thousand and twenty-five feet above tide water. It is entirely surrounded by a granitic gneiss, distinctly stratified, easily decomposing, carrying granitic veins holding beryl, and recognized most readily by the common fact of showing on worn surfaces reticulated segregated veins. The junction of the gneiss and syenite was observed at the north end of the latter. The gneiss dipped southerly at a high angle, and the syenite lay upon it. On the west side the relations of the two are the same, the gneiss dipping south of east, being nearly vertical. Upon the east side the strata dip equally high in the opposite direction, or toward Red Hill. Thus the syenite would seem to lie in a synclinal axis. Nothing like stratification could be discerned in the upper rock. We may suppose it to be eruptive like that on Tripyramid. Small dikes of rock resembling labradorite cross the gneiss in Sandwich one or two hundred feet north of the syenite. Observations upon Mounts Gunstock and Belknap in Gilford brought to light immense masses of syenite and breccias, reminding one of Tripyramid. The same can be said of the mountains between Lancaster and the Grand Trunk Railroad, which are out of the limits of our map, else they would be described.

PROFESSOR VOSE'S REPORT.

In 1869 Mr. George L. Vose, since appointed Professor of Engineering at Bowdoin College, Brunswick, Maine, acted for a few weeks as an assistant upon the Geological survey. His geological researches extended over a part of the field now being described, and therefore I will present his report at this time, rather than reserve it for publication hereafter, as was intended. I have added in brackets the names of the rock to which he refers, to correspond with the usage of my own report.

PARIS, Me., Aug. 3d, 1869.

PROF. C. H. HITCHCOCK, *State Geologist of New Hampshire:*

MY DEAR SIR,—I have spent the month of July in examining the topography and geology of some portions of the towns of Jackson, Bartlett, Conway and Tamworth, and send herewith such information as I have obtained. The two packages of rocks forwarded to you at Hanover, with the tracings and the list at the end of this letter, will give you some idea of the character of the district.

At the west end of Ossipee Mount (see tracing No. 1), we find a rock like Nos. 43, 44, 45, [trachytic granite] apparently arranged in thick beds, running about N. W. and S. E., and dipping about 30° N. E. Just below the bridge, east of the church, at South Tamworth, and from that point to the Bearcamp, we find the rock No. 48 [Bethlehem gneiss?], in regular beds from one to six inches, and over, in thickness, running E. and W. and dipping about 20° N. A little lower down the Bearcamp, at the Rake factory, the rocks are again well shown, running S. 70° W. and dipping N. W. from 30 to 50°. Upon Chatham Hill (see tracing No. 1), are found Nos. 46, 47 [plumose mica and graphic granite]: but the rocks are arranged in a confused manner at this point. At Chocorua, in the Swift River Valley and all along through Conway and North Conway, we find the principal rock to be (Nos. 45 (A) and 13), a coarse granite with little or no mica. The same rock, or one very much like it, occurs at the southern base of Kiarsarge; but does not appear to extend higher up than four or five hundred feet above the base of the Mountain. The

"Ledges" opposite North Conway, are chiefly, if not entirely, of granite of various degrees of fineness. The vertical striped appearance of these ledges is due to the water which runs down over them, as far as I could judge, and does not show structure. The granitic rocks through the whole of this region are much cut up by joints, but whether any true bedding can be made out is doubtful. The five summits east of North Conway village, called the Green Hills, as also the "Ledges," and, in fact, all exposures of rock in this region, show what might perhaps be called horizontal or nearly horizontal stratification; but this bedding, if it is such, must not be confounded with an apparent bedding caused by a scaling off of the rock in concentric layers, from five to ten feet thick, an example of which may be seen in the upper part of the large or south ledge (White Horse ledge). Over the whole region from Jackson to Tamworth, and far over into Maine, there is seen a well marked orographic feature which *may give* a clue to the arrangement of the rocks in this district. I refer to the general outline of the hills; which present almost universally a long gentle slope to the N. and an abrupt face to the S. The dip of the rocks, too, where this can be made out is almost always from 20 to 80° to the *North* the *N. W.* or the *N. E.*

The same granite which appears at Chocorua, in the Green Hills, and all along through Conway, is found at Kiarsarge village, and in the lower part of the mountain itself. About 500 feet above the south base of Kiarsarge, and in the old foot-path (that of 1848) occurs a ledge of clay slate, directly above the granite. This formation does not seem to extend far, as it is not found in either of the new paths up the mountain, and a very short distance from its lower boundary we pass beyond it and come upon the rock of which the upper 2000 feet of Kiarsarge appears to consist, viz: a conglomerate, breccia, or something like it. (See No. 7, and also the various pebbles included in the rock and numbered 5.) The greater portion of the included fragments are slaty, lying at all angles, and are angular, and range in size from an inch to a foot in diameter; but the pebbles (Nos. 5) many of them rounded, also occur very frequently, and were all taken from the rock in place. The slate above referred to runs N. 70° E. S. 70° W., and dips from 50 to 80° N. W., being much twisted on the small scale. It does not appear either in the old or new roads, but the path of 1840 crosses over the ledge. Five hundred feet north and south and one thousand feet east and west seems to include the whole exposure, though farther examination may detect it elsewhere. The upper part of Kiarsarge shows two well-marked systems of joints, which seem to affect nearly the whole mountains. At the top, one set runs S. 60° W. and dips about 80° N. W., the other set runs N. 55° W. and dips about 80° S. W. It will be observed that the first set agree almost exactly with the strike and dip of the slate in the lower part of the mountain. In many places on the upper part of the mountain the rock has a thin bedded sort of structure parallel to the joint planes; but whether these divisions indicate a real highly inclined bedding remains to be seen. The upper three-fourths of Kiarsarge I should in no way call granite, as Jackson does; but the specimens show what the rock is. It is also quite plain that *rounded* pebbles of various sorts of rock occur in the whole upper part of Kiarsarge.

At Goodrich's Falls, in Jackson, the jointing and quasi-bedding of the granite is very well seen from above the bridge to below the falls. One set of joints runs N. 80° W. and dips steep to the N. The other set runs S. W. The granite at this place decomposes in a remarkable and instructive manner; showing the original structure of the rock better by the decay than by the solid ledge. (See sketch.)

Going towards the Glen, from Jackson, at about two miles above Jackson, ledges appear on the west side of Ellis River of the rock Nos. 17–18, running S. 33 W. and dipping N. W. about 45°, and cut by joints running S. 75° W. and dipping about 80° S. At many points along both road and river the same formation is seen; and at Fernald's, five miles above Jackson, it is particularly well exposed running S. 33° W. and dipping 25° N. W. The rock at this last place [belongs to the White Mountain series]. At Glen Ellis Falls, eight miles above Jackson, [gneiss] is found with a slight dip towards the N. Just above the stopping place at Glen Ellis Falls, on the east side of the road, the slates are again seen running N. 30° E., S. 30° W. and dipping about 50° N. W.

At Crystal Cascade, three miles south of the Glen and west of the road, the slates are disturbed and twisted in a remarkable manner, and much mixed with other rocks. At the little foot bridge below the cascade the rock is granitic. Just north of the Glen House, in the road, the slates are seen again running N. E., S. W., and dipping 30° N. W.

At Jackson Falls the rock, granite, in the bed of the stream is cut by several sets of joints, the most marked running nearly N. and S. and dipping steep to the west. These joints are so general and so well-marked as to resemble bedding. Two and a half miles above Jackson on the Wildcat Branch, the rock [compact porphyritic felsite] is found in the bed of the stream, just above the bridge. At the tin mines about a mile N. E. of Jackson, and perhaps 500 feet above the river, are several openings made for ore. At the lower mine we find the main rock to be [syenitic, referred to by Mr. Huntington]; at the middle opening [dark felsite] and at the upper opening {dark quartzite]; at the last place occurs also in thin beds [a light compact feldspar.] Upon a hill on the road running to the Rocky Branch, and three miles due west from Jackson village, the rock is mica slate running E. and W. and dipping 80° N., the rock being much twisted.

The south peak of Doublehead consists of [granite.] The rock is exposed in large ledges on the south slope, and lies in broad tabular masses, with an apparent dip to the south; this is most likely the concentric scaling off of the rock before referred to. Near the top of the south peak are seen true beds running S. 60° E. and dipping 45° N. E.

In the depression just north of Thorn Mt., in the high cleaving, the rocks are very confusedly mixed, and are shown by Nos. 33 to 38 [mica schists and trachytic granite.]

With regard to surface geology, terraces and "moraine hills" may be seen in nearly all of the White Mt. valleys; but I have mapped none as yet. Perhaps the finest terrace is that upon which North Conway stands, a good section of which may be seen just below the saw mills, at the lower end of the village. This terrace, which is from 30 to 40 feet in height, consists of fine sand in the upper part, and in some places of a compact dark sand beneath. In the beds of some of the brooks which flow through the meadows is found the true stiff blue clay.

Glacial furrows are common throughout this region. The general course, as noted both at high and low elevations, is *south-easterly*, but cases occur where the course is *west* of S. There is but little evidence of the action of local glaciers in Bartlett and Conway, so far as I have examined the ground. I should rather conclude that the few variations from the common course of S. 15° to 30° E. were caused by the effect of local topographical features upon the general mass of ice which has moved over this part of New England.

I have as yet done little directly towards the topography of the mountain region. There are now existing three maps of the White Mountains; Bond's, Boardman's, and the County maps. The first of these was founded upon a triangulation made with great care by the late Geo. P. Bond of Cambridge, and as far as concerns the position of the principal peaks it is by far the most correct map extant; in matters of detail, however, it is not sufficiently reliable for entering geological notes. Boardman's map was intended simply as a tourist's guide. In matters of detail it is not at all accurate and it does not embrace the whole mountain region. The County maps where the country is thickly settled are tolerably correct, and are useful for entering notes; but in the fixing of the chief points, in town and county boundaries, and in details where the country is not settled, they are quite incorrect. I have thus far measured a series of angles from the summit of Kiarsarge and a part of a series from the summit of Chocorua. The results obtained are almost indentical with those published by Mr. Bond; so much so that if my notes were plotted upon his map no difference in position of the principal peaks would be seen.

Very truly your obedient servant.

GEO. L. VOSE.

MOUNT KIARSARGE.

A few more words about the geology of this mountain. The map shows the relative position of the several rocks. The coarse granite occupies the valley of the Saco and the hills south, as well as a limited band to the east, between the mountain and the Maine line. Above this most distinctly, upon three sides (the fourth has not been explored), the trachytic granite occurs. It is not abundant on the south and east, but very characteristic. On the south it crops out on the hillside below the slate. There is little to add to Mr. Vose's description of the slate. It is above the trachytic granite, and, in this respect, is like the felsites of Pemigewasset, but, unlike them, has been much twisted and reposes on the top of the terrace, inclined at a high angle. No doubt would be entertained respecting its very much later origin than the upper two thousand feet of the mountain, except that the latter is partly composed of fragments of slate, evidently derived from this formation. The lower portions adjacent to the slate are chiefly composed of it, and even at the summit small dark pieces, apparently of the same material, abound. A similar rock with dark fragments is found on Twin Mountain. The composition of the cement (Analysis XI.) shows it to be allied in character to the felsites elsewhere found overlying the trachytic granite.

A somewhat similar slate occurs between Mount Willard and Mount Lincoln. Specimens from the two localities are not distinguishable from each other, and the mass of Mount Willard is a trachytic granite. There slaty rocks pass into quartzites, if not into felsites, and cover a considerable area—including the country from Mount Willey to beyond Mount Tom, over three miles. Well-marked crystals of andalusite are found in a similar slate at the base of Mount Tom, which seems to ally the series with the andalusite slates of the Coos group along the headwaters of Ellis river, at the east side of Mount Washington. I observed that jointed planes existed in the trachytic granite parallel with the slaty strata above them on Mount Willard, like those described upon Kiarsarge. Passing to the first peak of Mount Lincoln the line of union of the granite and slate was traversed, having a compass course of N. 25° W. In the saddle of Lincoln the slates dipped 50° S. 20° W. But on the mountains south are found nothing to correspond with the feldspathic and brecciated cap of Kiarsarge. The relations of this slate to the granite and felsites demand further examination.

RELATIVE POSITION.

A few considerations will serve to indicate the probable relative positions of the rocks that have been described. The sections given of the common granite, trachyite granite and the norian series, (or at least certain felsites,) seem to determine their relative positions, the last being at the top. The brecciated granites of Franconia seem to be older than any of these, and to underlie them as already stated, and hence there may not be any correspondence between them and the breccias made up of felsites and Labradorite. If these points are assumed, the porphyritic gneiss can be shown to be at the bottom of the series, for it lies outside of the lowest of them. Two principal ranges of this rock enter the limits of our map. The eastern is cut off abruptly by the norian at Waterville, crossing at an angle of at least seventy degrees, and as much as fifty degrees in the dip. Another exposure of the same band of gneiss appears at the base of Mount Carrigain, standing nearly vertically. Passing from this across to the western range we travel fifteen miles. An anticlinal is hardly supposable over so great a distance. The dips have not been observed systematically, but the western range from the Pemigewasset to Moosilauk has an anticlinal form, and comes up again west of Moosilauk so as to underlie a synclinal mass of andalusite schist or gneiss. This structure agrees with its position as deduced from other facts. The andalusite rock is repeated east of the Pemigewasset in an anticlinal way, so as to correspond — as shown by its distribution on the map.

The porphyritic gneiss west of Echo Lake dips northwestwardly. At the Lake of the Clouds the dip was not measured; on the ridge running south it dips 50° easterly. Below Walker's Falls it stands nearly vertical. Our notes represent a feldspatho-hornblendic rock in horizontal plates immediately contiguous on the east, most likely lying upon the edges of this gneiss. If this prove correct then the rest of the intermediate space to the crest of the range will be found occupied by the trachytic granite, the horizontal plates showing its beginning. If the horizontal position of the granites and felsites are to be regarded as produced by original deposition, then the elevation of the gneiss took place first, and this mass of mountains has been scarcely disturbed by elevating forces since that time.

The porphyritic area along the Ammonoosuc is probably a repetition of that near Echo Lake, making a synclinal axis, just as in Benton under Moosilauk. With this premiss we can infer that the gneiss of Bethlehem was found subsequently, and lies in a basin — with an east and west axis.

We cannot as yet locate the andalusite gneiss, save that it is newer than the porphyritic bands, as shown at Moosilauk. There will be abundant opportunity the coming season to compare the formation with the norian, where the two come in contact.

There is one further suggestion in respect to relative ages. The Coos group of Littleton and Lisbon passes around the west end of the Bethlehem gneiss, showing that the latter existed before either the deposition or elevation of the former. This indicates that the whole of the White Mountain rocks are more ancient than the Coos and Quebec groups of the Connecticut valley.

Without further discussion of this interesting topic, I will proceed to present the most important analyses in our possession, of the rocks of which so much has been said. Most of them are published now for the first time.

ANALYSIS.

I. Labradorite, Waterville. By E. S. Dana.
II. Labradorite, Waterville. By E. S. Dana.
III. Chrysolite, Waterville. By E. S. Dana.
IV. Light colored feldspar from the syenitic rock of Tripyramid. By C. A. Seely.
V. Feldspar from Sawyer's Rock. By C. A. Seely.
VI. Dark compact felsite, Cape Horn, Northumberland. By C. A. Seely.
VII. Dark compact felsite, boulder, Waterville. By C. A. Seely.
VIII. Yellowish compact felsite, Berlin. By C. A. Seely.
IX. Feldspar, Mt. Pequawket. By C. A. Seely.
X. Orthoclase, Lightning Mountain, Strafford. By C. A. Seely.
XI. Orthoclase from trachytic granite, Albany. By C. A. Seely.
XII. Red feldspar from syenite of Tripyramid. By C. A. Seely.
XIII. Labradorite, Waterville. By T. S. Hunt.

	Silica.	Alumina.	Iron Oxyd.	Magnesia.	Lime.	Soda.	Potash.	
I.	51.03	26.20	4.96	—	14.16	3.44	.58	= 100.37
II.	52.25	27.51	1.08	.99	13.22	3.68	2.18	= 100.91
III.	38.85	tr.	28.07	30.62	1.43			= 100.21
IV.	59.2	28.8	tr.	—	7.40	8.54	0.6	
V.	66.6	20.4	tr.	—	2.8	7.28	5.47	
VI.	62.2	28.	tr.	—	4.6	3.34	6.	
VII.	69.6	17.8	4.5	—	4.8	3.31	4.51	
VIII.	69.2	19.6	—	—	3.	—	—	
IX.	69.6	22.6	—	—	3.4	—	—	
X.	63.2	24.	—	—	1.6	—	—	
XI.	61.6	22.2	—	—	.8	—	—	
XII.	57.6	24.6		—	3.2			
XIII.	50.30	25.10	4.23	2.95	14.07	2.65		= 99.30
XIV.	64.90	8.80	12.60	2.37	3.50	4.24	6.25	
XV.		—	—	—	—	3.959	6.525	
XVI.	52.01	26.60	4.20	—	13.30	3.50	.65	= 100.26
XVII.	51.50	25.90	5.00	—	14.29	2.95	.50	= 100.14

XIV. Red compact felsite, Albany. By C. A. Seely.
XV. Red compact felsite, boulder, Waterville slide. By C. A. Seely.

XVI. Dark compact felsite, south end of Lafayette range. By B. T. Blanpied.

XVII. Labradorite, Dry River, five miles from Mt. Washington. By B. T. Blanpied.

Remarks. The first three by Mr. Dana were published in the "American Journal of Science," January, 1872. The mean of two determinations is given except in the case of the alkalies. In No. I a very little titanic acid was present, and not separated from the alumina. The mineral taken came from the dark colored rock named *Ossipyte*, consisting mainly of the triclinic feldspar with small yellowish grains of chrysolite. It has a dark, smoky color, not iridescent, beautifully striated, fuses more readily before the blowpipe than ordinary labradorite, and is but slightly attacked by acids. The iron was determined volumetrically, and proved to be more abundant than anticipated. Mr. Dana observed grains of an iron ore under the microscope from one-fiftieth to over two hundredths of an inch in diameter, which were strongly attracted by the magnet, and hence not a part of the labradorite. Microscopic specks less than one ten thousandth of an inch in size were thought to be cavities in the mineral. The color may be explained by the presence of the iron ore. The latter mineral proved to be a very magnetic titanic iron, judging from careful qualitative tests.

II. This labradorite came from the "Notch" on Norway Brook, occurring in large cleavable masses, often half an inch long, in company with hornblende for the principal mass; besides magnetic titanic iron, a little dark brown mica and less epidote. The color is grayish-white, there is no iridescence, and striations appear only after careful search. Both these analyses show an unusually large proportion of lime for labradorite.

III. One and twenty-four hundredths per cent. of manganese oxyd is not reported in the table. This chrysolite contains an unusually large percentage of iron; thought by Mr. Dana to be a constituent of the mineral and not an impurity. The oxygen ratio of the bases and silica is nearly 1 : 1, and of the iron and magnesia about 1:2. This is the same ratio as that usually deduced for hyalosiderite, but the mineral differs from the latter compound in being less fusible. The chrysolite is nearly infusible before the blowpipe.

The rock whence the chrysolite came is that from whence No. 1 was taken. The average amount of magnesia present in the whole rock is 1.82 per cent. which would give 5.94 as the per centage of crysolite present. As this assemblage of minerals has never before received a distinctive name, Mr. Dana has thought best to apply a new designation for it, calling it *Ossipyte*, after the name of the Ossipee Indians who formerly dwelt in eastern New Hampshire. This seems to be the most common of the norian rocks along Norway brook, and has also been found further north.

The analyses from III. to XII. inclusive were made by Charles A. Seely of New York, chemist of the survey. The silica, alumina and iron oxyd, and lime were first determined; afterwards the iron oxyd was separated from the alumina, and the alkalies and magnesia weighed each by itself in a new sample of rock.

IV. This feldspar corresponds well in composition with *andesite*. The rock is a compound of andesite, orthoclase and mica, or sometimes hornblende. It constitutes essentially the whole mass of the Tripyramid. At the typical locality in the Andes it is said to come from a "syenite-like rock," just as in New Hampshire. Some analyses of norian andesites from Chateau Richer in Canada, by Dr. Hunt, agree well with this.

V. Sawyer's rock is a mountain range almost cutting across Saco river at the west line of Bartlett. It is, perhaps, more like albite than orthoclase in composition, mainly on account of the greater proportion of soda present. A larger percentage of lime was anticipated. The rock is referred to the trachytic granite layer.

VI. This specimen was thought to be a compact labradorite. It proves not very unlike the orthoclase felsites, VII. VIII. XII. and XV. All these felsites, however, contain an unusual quantity of lime, such as we shall expect to find in connection with labradorite.

VII. This represents the composition of the felsites south of the Twin Mountains.

VIII comes from a different formation, north of the White Mountains.

IX. Scarcely enough of IX. is determined to enable us to speak confidently of the species to which the feldspar should be referred.

On account of the fineness of the texture the analysis is given of the whole rock, rather than of separate crystals.

X. The rock from whence this feldspar comes closely resembled labradorite superficially. It proves to be orthoclase, and the accompanying mineral is quartz, and not chrysolite. The locality is far north of the usual norian rocks, and rests upon granite like that of Franconia.

XI. The singular texture of the trachytic granite of Albany made its analysis desirable. The crystals of feldspar scattered, through it are judged to be orthoclase. The rock apparently resembles that denominated "granitoid trachyte" by Dr. Sterry Hunt, from the province of Quebec. The red feldspar (XII.), from the syenite of Tripyramid, accompanies IV. The analysis is not yet quite complete. Dr. Hunt and Prof. Dana have remarked sufficiently upon XIII. in their letters. The large amount of iron in XIV. shows why the rock is red, and the analysis shows that the rock is not jasper, as at first supposed, but probably orthoclase. [See pages 17 and 19 for the localities of Analyses XVI. and XVII.]

THE STATE MAP.

In a previous report your State Geologist set forth the necessity of a good topographical map of the state as a basis for the proper delineation of the results of the survey, as well as for ordinary purposes by the public. With the approval of the governor and council an effort has been made to collect materials for a map drawn upon the scale of two and a half miles to the inch, in connection with the regular work of the survey. Two years since it was thought that the information gathered might be compiled into a very satisfactory map, such as is called for by the wants of citizens and the great throng of summer visitors. Parties were found who were willing to join with the state authorities in engraving such a map, provided that the topographical parts should be etched on copper. The Legislature did not adopt this proposition on account of the expense involved. At the ensuing session a proposal was made that the state undertake the preparation of a new map, and that each town should survey its own territory, sending the results to a commissioner appointed by the governor and council. This proposal failed to meet the legislative approval for a similar reason. Hence your geologist cast about for other methods of completing the publication of a reliable map. Fortunately Messrs. Sanford and Everts, publishers of the Strafford county map, of His Excellency Governor Weston's map of Manchester and the delineation of the southern part of the state prepared for the New Hampshire Fire Insurance company, had taken a great interest in the publication of maps, and were disposed to push forward the project of publishing a map of New Hampshire by subscription. Arrangements have therefore been made by which they will publish the materials that have been collected, including that held by the proprietors of the county maps. Hence we may expect, a twelvemonth from now, a topographical atlas of the state, which will be brought to the notice of all who may desire to secure copies for themselves. The publishers, however, do not feel authorized to engrave the map on copper, because of the great expense of metal over stone work. If aid could be furnished by the state in furtherance of this object, the publishers would greatly improve the style of the map, while the public authorities might control the use of the plates hereafter.

Last year I mentioned that Congress had authorized the Coast Survey to extend their triangulation into the interior of those states which were carrying on geological surveys. This task in New Hampshire has been executed the past year by Prof. E. T. Quimby, and the results have been forwarded to Washington. During the coming summer the work will be prosecuted yet more energetically under the same administrator. Professor Quimby has kindly volunteered to determine the exact latitude and longitude of all points where signals may be placed by individuals in the central part of the state, and it is to be hoped that there will be numerous responses to his circular.

THE FINAL REPORT.

So much progress has been made by our explorations, that in pursuance of the Legislative Act authorizing the survey, we have commenced the preparation of our Final Report. This will be written as rapidly as our knowledge of the facts will permit. The plan laid out is something as follows:

PART I. PHYSICAL GEOGRAPHY.

a. Orography, or the delineation and study of the mountains.

b. Cartography, or history of the map literature of the state.

c. Distribution of the plants and trees, as related to Geological History.

d. Distribution of the animals, as related to Geological History.

e. Magnetography, or the discussion of facts relating to terrestrial magnetism, variation of the needle, etc.

f. Climatology.

g. Geology as related to Scenery.

h. History of White Mountain Exploration.

i. Tables of altitudes.

PART II. STRATIGRAPHICAL GEOLOGY.

Introduction. Relations of tho Geology of New Hampshire to that of New England.

A. Description of the Geology of the Schistose Region of the Hydrographic Basin of Connecticut River. 1. Underlying granites; 2. Gneiss; 3. Norian rocks, including eruptive syenites; 4. Metamorphic Quebec Group of Logan, or Upper Huronian of Hunt; 5. Coos Group—this embraces, (*a*) quartzite, (*b*) limestone, (*c*) mica schist, (*d*) staurolite schist, (*e*) wrinkled schist, (*f*) decomposing slates, (*g*) calciferous mica schist, (*h*) dikes; 6. Clay slates; 7. Helderberg limestones and slates.

B. Description of the Central Gneissic Region. This must embrace numerous divisions whose relative chronology is undetermined at present. I. Porphyritic gneiss: 2. Bethlehem gneiss; 3. Gneiss about Winnepisseogee Lake; 4. Gneiss carrying large beryl-bearing veins; 5, Gneiss subdivided by bands of quartzite in the more southern part of the state; 6. White Mountain gneiss; 7. Granites; 8. Norite rocks including syenites; 9. Andalusite slates; 10. Igneous rocks.

C. Description of the Geology of the Coast Region.

D. Description of thirteen sections crossing the state in east and west lines.

E. Economic Geology. 1. Building Materials—Granite, slate, flagstone, limestone, soapstone, clay for bricks, etc.; 2. Use in the arts—enameled slate, quartz and feldspar for glass, mica, soapstone, serpentine, plumbago, precious stones, fluor spar, polishing powder, moulding sand, ochres for paints, etc.; 3. Agricultural—peat, marl, phosphate of lime, limestone, scythe stones, etc.; 4. Chemical—Copperas, alum, titanium, arsenic, and the metals gold, silver, copper, iron, lead, manganese, tin, molybdenum, zinc.

PART III. DYNAMICAL AND THEORETICAL GEOLOGY.

a. Elevation of mountains.

b. Metamorphism.

PART IV. MINERALOGY.

PART V. MICROSCOPY.

Both micro-petrology, or the study of the rocks under the microscope, and the examination of beds of polishing powder, etc.

PART VI. PALEONTOLOGY.

PART VII. SURFACE GEOLOGY.

The proper treatment of all these topics will require a book of quarto size, of several hundred pages, and an atlas of maps, with other illustrations.

ALTITUDES.

The levelling along Connecticut River has been farther prosecuted. The work above Hanover was performed last summer under the direction of A. F. Reed, of Groton, Mass., assisted between Hanover and Lancaster by Dr. Nathan Barrows, of Meriden, and between Lancaster and Connecticut Lake by Messrs. C. F. and F. A. Bradley, of the class of 1873, Dartmouth College. The results are given below. We hope to complete the gap between White River Junction and Brattleboro the coming season.

Frequent application has been made to us for heights of various points, and therefore it seems desirable that such as have been well measured should be given, together with a statement of the surveyor and the method employed. These are compiled from a more copious list in our possession:

Heights along the Concord and Portsmouth Railroad.

Levelled by Frank Woodbrige, in 1870, for the Geological Survey.

On Monday, May 2, 1870, the mean tide at the Great Bay R. R. bridge, measured 10.7 feet below the bottom of the rail. The following heights are above the mean tide at Great Bay for this day:

	Feet.
Newmarket Junction	51.916
Littlefield's Crossing	126.053
Epping	154.147
Raymond	197.881
Candia	445.190
Manchester, center of depot	180.832
Top of dam at Manchester	176.980
Amoskeag base line	108.980

Survey used in the Construction of the Road.

Level water at Great Bay Bridge	0
Newmarket Junction	48
Piscasset River, (water level) S. Newmarket, 68; track	73
Epping Depot	144
Lamprey River, (water level)	141
Same at Raymond	173
Raymond Depot	191
Outlet of Jones Pond, (water level)	258

	Feet.
Road at Patten's Shingle Mill, Candia	373
Level of ground at do.,	354
Brook east of Candia Depot, (water level)	410
Candia Depot	445
Carr's Crossing, Candia	485
Summit at Kinnecum's Swamp	528
Turnpike at Rowe's Corner	453
Sawyer's Pond	419
Lakin's Pond	307
Suncook River	208
Railroad over Suncook River	258
Summit in Candia on R.R. after construction to Manchester	465
Auburn Depot	289
Massabesic Pond	255
Summit between Massabesic and Merrimack River at J. P. Eaton's	344

By another Route.

Bean's Island, Candia	275
Lamprey River, Candia Village	301
Highway in Candia Village	310
Summit	550
Turnpike near Rowe's Corner	450

A Survey through Deerfield.

Quincy Pond, Nottingham	288
Summit between Quincy Pond and Lamprey River	406
Summit	576
Suncook River, Beech Street	259
Suncook Village	281

Suncook Valley Railroad.

Furnished, by the Hon. S. N. Bell, President, from surveys of Hon. J. A. Weston.

Assume level of track at Bridge over Suncook River as	235
Highway crossing near Suncook House	295
Highway crossing near Tennant's S. M.,	300
Highway crossing Buck St., Allenstown	335
Bear Brook, (water level)	290
Highway crossing at Jenness Corner	335
Mouth of Little Suncook River	334
Chichester Pine Ground, (R. R. crossing)	372
Highway crossing near Webster's Mills	410
Pittsfield Depot	495

Additional surveys of J. A. Weston.

Railroad track at Pittsfield, 299 feet above track at Hooksett water station; railroad track at Alton, 322 feet above the same; summit between Pittsfield and Alton, 508 feet above the same.

The following elevations are above the railroad track at the Manchester Depot:

	Feet.
Railroad track (Manchester & No. Weare) at Goffstown,	123.26
Railroad track (Manchester & No. Weare) at Parker's Station,	137.86
Piscataquog River at Parker's Station, Goffstown	117.86
Piscataquog River below bridge at New Boston Village	241.00
Piscataquog River at west line of New Boston	333.80
Francestown Turnpike near northeast corner of Lyndeborough	432.70
Forrest road south of Greenfield Center, (summit in railroad survey)	734.86
Meadows between Greenfield and Peterborough and near Greenfield,	635.00
Contoocook River above stone bridge and dam at Peterborough Center	553.00
Meadow on Goose Brook above West Peterboro'	746
Long Meadow on Goose Brook in Hillsborough and Dublin,	779
North Pond in Harrisville,	1037
Summit on railroad survey in Harrisville	1084
Mud Pond in Harrisville,	1075
Reservoir at head of "Gulf" in Marlborough,	956
Cheshire railroad near arch bridge at So. Keene,	777
Summit on preliminary survey of Monadnock R. R. in Rindge,	883
Cheshire railroad track at State Line	750
Cheshire railroad track at Winchendon Depot,	826

Heights along Northern Railroad,

Assuming Concord Depot to be 252.39 above mean tide.

Fisherville Bridge	267.89
Boscawen	273.89
North Boscawen	290.01
Webster Place	295.26
Franklin	363.26
East Andover	661
Andover	628
Potter Place	653
West Andover	677
South Danbury	732
Danbury	826
Grafton	848

	Feet.
Grafton Center	871.65
Tewksbury Pond	904
Orange Summit	990
Railroad at Mud Pond	957
Canaan	956
West Canaan	813
Enfield	768.34
East Lebanon	765.63
Lebanon	510.31
West Lebanon	376.13
Bridge over Connecticut River	376.13
Connecticut River, high water	352.84
Connecticut River, low water	330.07
White River Junction	369.23

Surveys along Connecticut River.

Canal survey in 1825, made under the direction of Holmes Hutchinson, Esq., and communicated by Dr. E. E. Phelps, of Windsor, Vt., Hartford, Ct., taken as the initial point, or zero:

Foot of Turner's Falls, near Greenfield	91
Mouth of Miller's River, Northfield, Mass.	154
Head of Stebbin's Island, Hinsdale	165
One mile north of Westmoreland Village	178
Mouth of Cold River	193
One mile below Little Sugar River	248
One mile below Chase's Island	260
One mile above Hart's Island, Plainfield	272
One mile above Lyman's Bridge, West Lebanon	296
One mile above Orford Village	337
Two miles above Haverhill Village	347
One-half mile above Howard's Island	364
Dodge's Falls	376
Foot of McIndoe's Falls	391.5

Surveys of Vermont Central Railroad.

Height given above Lake Champlain on original profile, to which 92 is added to give height above the ocean:

Windsor	322.8
Hartland	412.8
North Hartland	379.6
White River Junction	340.7
White River Village	376.2
Woodstock Station	420
West Hartford	414.4

Survey by A. F. Reed, 1871,

Taking White River Junction as 369.23, and following Passumpsic Railroad.

	Feet.
Railroad, Norwich, Vt.	406.300
South end of bridge over Pompanoosuc River	409.027
Crossing near Mr. Blood's, Norwich, minimum grade	395.064
Crossing one and one-fourths mile south of East Thetford	410.145
East Thetford Depot	413.325
North Thetford Depot	401.741
Crossing one and one-half miles north	420.233
Crossing two and one-half miles north	435.741
Crossing one and one-half miles south of Fairlee	432.781
Fairlee	437.952
Water House, railroad, Sawyer's Mountain	449.439
Piermont Station	439.627
Bradford Station	410.007
Crossing two miles south of Haverhill	408.912
Chamberlin's Crossing	409.071
Hall's Brook	410.027
Haverhill Depot	412.142
Crossing to Newbury Bridge over Connecticut	413.857
Newbury Depot	426.002
Wells River Depot	442.898
Crossing three miles north	437.642
Ryegate Depot, platform	471.710
Crossing one mile south of McIndoes	494.895
McIndoe's Depot	487.913
Barnet Depot, last point measured on the railroad	467.114
Hay scales, Upper Waterford	752.368
Bridge, Upper Waterford, 15 feet above water	689.046
Piazza, Sumner House, Dalton	895.653
Top of stone hitching post, south end of Dalton post office	910.108
Door of County House, Lancaster	864.944
Hay scales, Northumberland.	862.852
Bridge over Ammonoosuc River, Groveton	880.170
Groveton Depot, (Grand Trunk Railroad)	898.410
Railroad Bridge two miles above Groveton	903.133
Stratford Hollow Depot	874.888
Stratford, flag station	877.742
North Stratford Station	912.684
Columbia Bridge	1008.768
Colebrook Bridge	1023.174
Middle of window on school house five miles north of Colebrook	1076.284
East end of Canaan Bridge over Connecticut River	1051.199
Bridge over Hall's Stream	1095.463
Foundation of red school house at the "Hollow," six miles from Connecticut Lake	1492.470
Connecticut Lake	1616.106

Elevation of points on and along the Portland and Ogdensburg Railroad.

Obtained by spirit level from a datum base, at mean low water of Casco Bay, as established by engineers of U. S. C. S. Initial point of distances at the west end of P. and K. Railroad Co's freight house, in Portland, Me. Furnished by John F. Anderson, Engineer of P. and O. Railroad:

Localities in Maine.

	Distance in miles.	Height in feet.
Surface of Presumscot River, on ice	5.64	43
Surface of Presumscot River, on ice	13	134
Surface of Sebago Lake, on ice	17	267
Steep Falls of the Saco River (village)	24.5	309
Surface of the Saco River, at mouth of the Ossipee	32	270
Surface of Ingalls's Pond near head of Great Falls, Saco River	35.4	354
Fryeburg Station, natural surface of plain	49.7	424
Highway at state line, Maine and New Hampshire	51	455

Localities in New Hampshire.

Saco River at R. R. crossing, Conway Centre	55.25	416
Surface of North Conway Village, Terrace Plain	60	525
Saco River at junction of the Ellis River	64.5	515
Saco River at junction of the Rocky Branch	66	564
Surface of Plain of Upper Bartlett Village	70.5	664
Saco River at line between Bartlett and Hart's Location	72.5	749
Surface of Sawyer's River at Highway Bridge	74.2	867
Surface of Nancy's Brook at Highway Bridge	76.2	1007
Highway at Willey House	82.2	1327
South end of Gate of Notch	84.3	1823
Crawford House	85	1903

CONWAY, April 10th, 1872.

C. H. HITCHCOCK, ESQ.,—*Dear Sir:* I send you the following statement, of the elevations of several points on our Portsmouth, Great Falls and Conway Railroad, verified by a direct course of levelling from middle tide water at Portsmouth. All levels taken on top of the rail in front of the passenger houses and refer to half tide or ocean level:

	Feet.
Brock's Crossing station, 10 1-2 miles from Portsmouth, by P. S. and P. Road	94
Great Falls station, 16 1-2 miles from Portsmouth, about 12 feet higher than dam	178
Rochester Station 23 miles level plain	226
Milton Station, say 6 feet higher than three-ponds, 31 miles	415
Wakefield Station (summit 42 1-2 miles) perhaps ten feet lower than the Village street	690
East Wakefield (summit) 46 1-4 miles	678
Ossipee 1-4 of a mile from village, 54 3-10 miles	642

	Feet.
Summit 1-4 mile farther on, 54 1-2 miles	654
West Ossipee, 64 3-4 miles on flat land in vicinity of Ossipee Pond and near the hotel of H. T. Banks, perhaps 20 feet higher than pond 3 miles off	428
Madison, 69 1-2 miles, north west end of 6 mile pond (Silver Lake)	476
Summit, 71 1-4 miles (No. Station)	516
Conway Corner (Shatagee) west end of village, 76 6-10 miles	466
Crossing Saco River, summer level, 80 miles	446
North Conway Station, 9 feet lower than the Plain, 82 miles	516
Jackson, on the road between the two bridges, 90 miles from Portsmouth	759

Respectfully,

T. WILLIS PRATT, *Engineer.*

Heights of several points above Tide Water between Boston and the Connecticut River near Charlestown, N. H., via Lowell, Nashua, Wilton, and Forest Road.

Mostly from levels taken under the direction of Geo. Stark, communicated by M. W. Oliver, Engineer B. L. & N. R. R.

Merrimack St. Depot, Lowell	87
Lowell Depot, Nashua	123
Main St., East Wilton	323
Near Hotel in Greenfield	830
Contoocook River on Forest Road between Greenfield and Hancock	635
Hancock St., between Church and Academy,	821
Water in Hancock Pond	787
Rye Pond, S. W. corner of Antrim	1230
Bridge on the Keene and Concord Road, east of "Box Tavern," Stoddard	1218
Upper or principal Island Pond, Stoddard	1243
Summit north of Wilson's	1555
Junction of Forest and Keene Roads near Marlow	1183
Pond at Marlow	1118
Junction of Old and New Forest Roads	1328
Gustin Pond	1245
Forest Road Bridge over Cold River	614
Sills of Universalist Meeting House, Paper Mill Village	470
Low-water mark, Connecticut River at Ingersoll's Bridge	237
Peterborough Village	685
Spofford's Gap, between Temple and Kidder Mountains in Temple	1460
Hedgehog Gap, probably between Temple and Pack Monadnock Mountains in Temple	1452

	Feet.
Railroad at Mason Village	798
Hay Scales at New Ipswich	939
Harrisville	1178
Arlington Mass.,	36
Lexington Common, Mass.,	217
Bedford, Mass.,	170

The following are selected from a very large number on the E. & S. R. R., furnished with the following on Exeter River, by J. J. Bell, Esq., of Exeter:

Epping Depot	245.8
Junction with C. & P. R. R., 5000 feet east of Depot	235
Summit before reaching Piscasset River	244
B. & M. R. R. Depot, Exeter	153
Fifth crossing of Little River and lowest point,	117
Old road to Newburyport, north of Brown's	163
Hampton Falls River below Mill	136
Eastern R. R., a little below Salisbury Depot	123

On Exeter River, from Exeter Manufacturing Co's. survey in 1830. Base line, low tide, Exeter river, at the Village:

Exeter, both Dams	21.33
Rockingham Factory	34.29
Pickpocket	56.61
Copyhold, upper dam	113.14
Clarke's dam	178.57

This is the height of Phillips's Pond in Sandown, the head of the river.

Grand Trunk Railroad.

Height above datum line, 50 feet below tide, Three Rivers.

Line between Maine and New Hampshire	733
Shelburne	743
Gorham	833
Berlin Falls	1055
Milan Water Station	1100
West Milan,	1035
Stark	992
Northumberland	920
Stratford Hollow	897
North Stratford	935

Few Altitudes from Wells Water Power of Maine.

Umbagog Lake	1256
Mt. Carmel	3711
Crown Monument, corner between New Hampshire, Maine and Canada	2569
Northwest head of Megalloway River	2917

Merrimack River.

J. B. Francis of Lowell, Mass., furnishes the following altitudes along the Merrimack River:

	Feet.
Top of Dam at Pawtucket Fall, Lowell (above high water)	82
Top of Essex Co's dam, Lawrence (above high water)	34
Surface of River at N. H. state line (above high water)	86

Cheshire Railroad from Profile.

Height given from base line at Ashburnham Junction, Massachusetts. This is probably about fifty feet below Ashburnham Summit, on the Vermont and Massachusetts Railroad, which is 1,106 feet above the ocean. The signs + or — will indicate the relations of each point to the base line.

Ashburnham Summit	+ 70
North Ashburnham	+ 31 1-2
Winchendon	— 23
Winchendon Summit	+ 0.27
State Line	— 117.23
Lowest Point	— 122
Track at Collins Pond	+ 57
Fitzwilliam	+ 54
Fitzwilliam Summit	+ 143
Troy	— 7
Marlboro'	— 119
Keene	— 609
Surry Summit	— 270
E. Westmoreland	— 390
Westmoreland	— 585
Walpole	— 815
Bellows Falls	— 839
Mt. Kearsarge as measured by J. R. Eastman, corrected for his base line in Andover	2742

A few Heights from Jackson's Report.

Mann's Hotel, Randolph, above Lancaster	492
Lime Pond, Columbia, above Chamberlain's Hotel, Colebrook	380
Summit of Road, Dixville Notch, above do.	835
Locke's Tavern, Epsom, above the ocean	443
Deerfield	494
Greenfield	418
Kingston Tavern	70
Temple Mountain above Temple Hotel	814
Mt. Whiteface, above McCrillis House, Sandwich	2941
Mt. Pequawket	3358
Sunapee Lake	1080
Ossipee Mountain	2361
Gunstock, W. Peak, above Lake Winnipiseogee	1561

	Feet.
Gunstock N. Peak, above Lake Winnipiseogee	1969
Symmes' Hill, Hancock	496
Catamount Hill, Pittsfield	1415
Wingate's Strafford	748
Blue Mountain	1151

Boston, Concord and Montreal Railroad.

These figures were taken from Guyot's Memoir on the "Appalachian Mountain System," adding fifteen feet so as to make the starting point at Concord the same with that determined specially by the survey:

Meredith Village	557
Plymouth	488
Rumney	535
Warren	751
R. R. Summit	1078
E. Haverhill	788
Woodville	463
Connecticut River, low water	422
Bath	536
Lisbon	592
Littleton	832
Whitefield Summit	1072
Whitefield Village (not R. R.)	972
Lancaster	875

The following altitudes are copied from Guyot's Memoir upon the "Appalachian Mountain System." B. signifies mercurial barometer; P. L., pocket level; L., by levelling:

The Mt. Washington Chain.

B. Mt. Madison	5365
B. Gap between Madison and Adams	4912
B. Mt. Adams	5794
B. Gap between Adams and Jefferson	4939
B. Mt. Jefferson	5714
B. Gap between Jefferson and Clay	4979
B. Mt. Clay	5553
B. Gap between Clay and Washington	5417
B. Mt. Washington	6293
B. Gap between Washington and Monroe	5100
B. Lake of the Clouds	5009
B. Mt. Monroe	5384
B. Little Monroe, W.S.W. of Monroe	5204
B. Mt. Franklin	4904
B. Gap between Franklin and Pleasant	4400
B. Mt. Pleasant	4764
B. Gap between Pleasant and Clinton	4050
B. Mt. Clinton	4320

Various points about the Mountains.

		Feet.
B.	Bethlehem Village	1450
B.	Pierce's bridge over the Ammonoosuc	1221
P.L.	White Mountain House	1551
B.	Fabyan site (old house)	1583
B.	Cherry Mountain, summit of road	2192
P.L.	Cherry Mountain, approximately	3670
B.	Summit of road between Moose and Israel's Rivers	1446
B.	Peabody River, path crossing near Glen House	1543
L.	Glen House	1632
B.	Pinkham Notch summit, near Glen Ellis Falls	2018
B.	Hotel at foot of falls, Jackson	771
B.	Mt. Deception, near Fabyan's	2449
P.L.	Wild Cat Mountain	4350
P.L.	Mt. Carter, south peak	4830
P.L.	Mt. Carter, north peak	4702
P.L.	Mt. Moriah	4653
P.L.	Crawford Mountain	3134

Mountains in "Pemigewasset."

P.L.	Echo Mountain, highest point	3170
P.L.	Willey or Notch chain, lowest or 3d N.W. peak	4070
P.L.	Middle or highest peak about	4330
P.L.	Willey Mountain proper, front or east peak	4300
P.L.	Twin Mountain, the highest peak	4920
B.	Mt. Carrigain	4678
B.	Summit of eastern spur	4419
P.L.	Brick House Mountain, in the line N.E. two miles from Carrigain	3850
P.L.	Hancock Mountain (called Pemigewasset by Guyot)	4420
P.L.	Tremont Mountain	3393
P.L.	Green's Cliff	2958
P.L.	Table Mountain, three miles S.S.E. of Hart's ledge	3305
P.L.	Sandwich Dome, above Campton	3969
P.L.	Mt. Osceola, Waterville	4397
P.L.	Mt. Passaconnaway	4030
P.L.	Tripyramid	4086
P.L.	Chocorua	3540

Franconia Region.

B.	Franconia Iron Works	979
B.	Profile House	1974
B.	Franconia Notch	2014
B.	Echo Lake	1926
B.	Cabin, foot of Mt. Lafayette	1780
B.	Flume House, road in front	1431

		Feet.
P.L.	Eagle Cliff, facing Profile House	3446
B.	Eagle Head, near the pond	4216
B.	Eagle Pond, foot of last peak	4170
B.	Mt. Lafayette	5290
B.	Mt. Lafayette, south peak, "Mt. Lincoln" of Fifield	5101
P.L.	Blue Mountain, summit of Kinsman range	4370
P.L.	Mt. Kinsman about	4200
B.	Mt. Cannon, approx	3850

Other Localities.

B.	Moosilauk	4790
P.L.	Carr's Mountain	3480
P.L.	Owl's Head	2950
B.	Merrill's House, base of Moosilauk	1681
B.	Thornton, (west?) opposite P. O.	1223
	Railroad and canal, Lake Winnipisseogee, mean level	501
B.	Eastern summit of Red Hill	1769
B.	Western summit of Red Hill	2025
	Mt. Monadnock	3718

Barometical Measurements by J. H. Huntington, in 1870.

Water shed between east branch Pemigewasset and New Zealand River	2123
Willey Notch	2799
Second notch north of Carrigain near a pond	3224
First notch north of Carrigain	2465
Notch south-west of Carrigain	3126
Cascade a quarter of a mile east	2076
Water shed between east branch Pemigewasset and Swift River	2618
Mad River Notch	1815
Greely's Hotel, Waterville	1553
Percy Peak, north 3336; south	3149

MR. HUNTINGTON'S LABORS.

Mr. Huntington has continued his labors in behalf of the Survey during the past year. Until late in July he was occupied with the compilation of his Report upon the Geology of Coos County. He then took the field, and labored in the northern part of the state, also in Essex Co., Vt., the latter without cost to the Survey, though we receive the benefits of the exploration. In September he examined the formations near Jackson, Bartlett, Conway, Albany, etc., partly to carry on the search for norian rocks, and partly to examine the region of iron and tin, remaining in the field after the beginning of November. The winter months he spent in office work. Extracts from his report upon the iron ore in Bartlett, the search for tin, and a notice of the gold rocks in Pittsburg and adjacent formations in Canada are herewith presented.

IRON ORE IN BARTLETT.

A little south of west from the village of Jackson there is a high mountain ridge, the eastern extremity of which is known as Baldface. This ridge extends along the sea to the western slope of Mount Crawford, but it is cut by the valley of Rocky Branch, and also by a stream, Razen Branch, in the western part of Bartlett. This ridge, for the most part, is a coarse granite, composed chiefly of feldspar and quartz, but it contains some mica and generally manganese. In this granitic rock, in the northern part of the town of Bartlett, and east of Rocky Branch, occurs the most extensive deposit of workable iron ore ever found in New Hampshire.

In the ridges that project south from the ridge just mentioned, the granite is of a different texture, being more compact, and the feldspar, instead of being a light flesh color, is a dull gray, and more distinctly crystalline. This rock forms the precipitous cliffs north of the road running from Jackson to Upper Bartlett. North of the granite containing the iron, and forming the mountain south of the settlement in Jackson known as Green Hill, the rock is a mica schist, which passes into a quartzite. The schist dips N. 40° W. at an angle of 25°, and hence it rests upon the granite. On the eastern slope of the mountain is a schist entirely different from that which forms the mass of the mountains, and, besides, it has an easterly dip, and it seems probable that it is the remnant of a synclinal axis that once filled the valley of Ellis river.

This deposit of iron has been known for many years, and was first noticed by Mr. Meserve. It was visited by Dr. Jackson, and is thus described by him:

> "One of the veins at the upper opening measures thirty-seven feet in width in an east and west and sixteen in a north and south direction. The second opening two hundred feet lower down the slope of the hill exposes the ore, maintaining the same width. Three hundred feet lower down the vein is observed to narrow and is but ten feet wide, and four hundred feet farther

down the width increases to fifty-five feet. Five hundred and forty-six feet lower still there is a small opening or cave twenty feet deep, where the ore narrows again. On searching to the westward of this great vein, at a distance of two hundred and fifty feet, we soon discovered a new one, which appears to be of the largest dimensions. . . . Forty-nine feet farther westward the soil is full of angular fragments of the ore, indicating another vein. It is evident that this mountain is intersected by a great number of veins of excellent iron ore and will furnish an inexhaustible supply. It is proper here to remark that it is composed chiefly of the peroxide of iron, combined with a small proportion of the protoxide, and it contains a little oxide of manganese. From the composition of the ore we know that it will make excellent iron and the best kind of steel."

Fifty tons of the ore were sent to Sampson & Co., celebrated English iron and steel manufacturers, who have reported favorably upon its good qualities. In my examination of this ore deposit, the measurements for mapping the property were made by Daniel Barker, Esq., of Bangor, Me. Starting from the most westerly outcrop on the slope towards Rocky Branch, we found the principal outcrops to lie in a direct line running N. 42° E., and the entire distance one hundred and seventy-five rods. The last outcrop on the east is six feet in width. Measurements of the openings on the west slope towards Rocky Branch were made by Dr. Jackson when the mine was first opened, and could be done much more exact than now. In several places, particularly north of the line followed, there are indications of iron, which may prove as extensive as the beds already opened.

An analysis of the iron ore by Mr. Williams was as follows:

Peroxide of iron	69.4
Quartz and feldspar	25.2
Oxide of manganese	2.7

69.4 of peroxide, containing 48.117 per cent. of metallic iron.

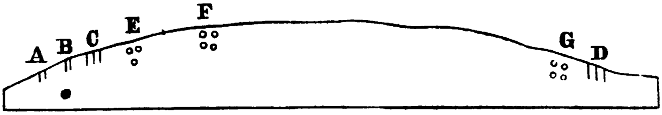
Another specimen yielded:

Peroxide and protoxide of iron	77.25
Quartz and feldspar	21.40
Alumina	.15
Manganese	1.20

Or 53 per cent. of metallic iron.

In the annexed diagram the relative situation of the principal openings are shown. A, B and C being those on the slope towards

Rocky Branch. D is the excavation on the east. The circles show sites where additional indications of ore may be seen. The vertical scale is four hundred feet to the inch, the horizontal sixty rods to the inch:



The masses of ore seem to be in vertical segregations, consequently there is more uncertainty as to their extending to a great depth, than if the ore occurred in lodes in a stratified rock, but this uncertainty is in a measure counterbalanced by the large masses in which the ore here occurs.

Until recently this ore has been far from any means of transportation by railway, but now the Portland and Ogdensburg Railroad, which extends through Bartlett, will pass within three miles of the mine, and a branch road can be easily built up Rocky Branch to a point where a tramway can be constructed to the shaft, and thus the ore can be moved altogether by steam.

The following may be considered a fair estimate as to cost of mining and profits:

200 tons of ore per day at $2.64	$528
General expense	50
Freight to Portland	300
Entire cost	$878
Value of ore at $6.00 per ton	$1,200

which leaves a margin of $322 per day as profit on a capital not exceeding $160,000.

The following is an estimate for a day provided the ore is smelted in the valley of Rocky Branch near the mine:

200 tons of ore at $2.64	$528
16,000 bushels of charcoal at $ .08	1,280
20 furnace men at $3.50 per day	70
160 laborers at $1.50	240
Limestone for flux	100
Repair, etc.	40
General expenses	250
Freight on 100 tons of iron to Portland	170
	$2,678

These figures at the present price of pig iron would leave a very large margin for profit, though the necessary outlay for the construction of furnaces, etc., would greatly increase the capital stock to be employed in carrying on the operations. The ore could probably be extracted, especially if it is done by open mining, at a much less cost than we have given in the above estimate, the location being favorable for this kind of excavation. The mine is owned by E. S. Coe & Co., of Bangor, Me..

SEARCH FOR TIN.

The relations of the rocks in Jackson are such that it has been considered a favorable locality in which there might be found workable lodes of tin. The occurrence of tin here was detected by Dr. Jackson in 1840, since that time several attempts have been made to develope the mine, but it seems that the parties have been easily discouraged as they have soon abandoned the undertaking. The following notes in regard to the working of the tin mine were furnished by Mr. Geo. N. Merrill, as also a view of the tin locality and a profile showing the situation of the schist and shafts. "The American Tin Company was chartered by the legislature of New Hampshire July 15, 1864, and they issued sixty thousand shares at $5 per share. The company secured one hundred acres of land on Tin Mountain and the mineral rights on nine hundred acres adjoining. The company actually expended and paid out $4,371.69. The last work done at the mine was in August, 1865. The company sunk two shafts, one twenty-five the other forty-five feet, and made an adit ninety feet. To have reached the main shaft would have required an adit four hundred feet in length." The rock excavated from the adit is composed mainly of a triclinic feldspar, probably labradorite, and with it is an orthoclase feldspar.

Considerable time has been devoted to exploring the country from Madison to Milan, where it was supposed, from the character of the rocks, that tin might be found. In many places there are indications of metallic deposits, but for the most part they are iron sulphides at least on the surface, while a few blasts might reveal something more valuable. However well versed a person may be in mining, every new mine that is discovered has characteristics peculiar to itself and these have to be carefully studied before any one can form a correct judgment in regard to it. Minerals present themselves too under so many different phases, and when exposed to the atmosphere are often so changed as scarcely to be recognized, that no one unless he has made explorations can form any estimate as to the time required or the labor necessary to be performed. In going from Robertson's Corner to Madison Corner just after passing the height of land south of the road we find the schist in many places pyritiferous and often much decomposed.

There are also numerous beds of granite or possibly they may be nothing more than immense veins. The schist where it does not contain pyrites is similar to that in Jackson where tin has been found, and here it underlies the White Mountain gneiss. In Jackson, every locality where it was thought there could be any show for tin, was examined, and an analysis of many of the specimens collected has been made by Professor Seely and very rarely has there been found even a trace of tin. The most promising localities away from the old opening are in the valley immediately north of Thorn Mountain and on the west slope of Black Mountain, and the tin rocks here underlie the andalusite schists, at least on south end of Black Mountain, and apparently uncomformably. On the west side of Tin Mountain near the Dundee road the schist is pyritiferous and there are numerous beds of granite, the rocks seem to be quite similar to those on the opposite side where tin has been found. Going north, the entire western slope of Black Mountain from its base half way up seems to be composed of pyritiferous schists, beds of granite and gneiss. There is a promising locality near Mr. J. R. Harriman's, also near the place formerly occupied by J. Y. Perkins.

In Berlin, on Cate's Hill, there is a combination of minerals rarely seen on the surface, pyrite, magnetite, hornblende, tremolite, chalcopyrite and bornite. The general appearance is exceedingly promising for copper if not for tin, but we have not been able to discover any place where the ore is concentrated in a vein, though there are several places where it is disseminated through the rock. Here, as elsewhere, the rocks differ somewhat in lithological characteristics from those at Jackson where we find the rocks containing tin interstratified with labradorite, which was not seen either in Madison or Berlin. From the occurrence of labradorite on Tin Mountain, probably on Thorn Mountain, and along the Saco toward the Notch, it seems to be quite certain that we have here quite a large area of upper laurentian rock.

ALLUVIAL GOLD OF INDIAN STREAM.

In that part of Quebec Province that lies between the St. Lawrence, Maine, New Hampshire and Vermont, the existence of gold in the alluvium has been known for many years. It is estimated that the area over which it extends comprises more than ten thousand square miles. The gravel containing gold rests generally upon metamorphic schists, some of which are associated with diorites and serpentines. Mr. A. Michel compares the gold deposits of Lower Canada with those of Siberia In the Ural and Altai Mountains the arniferous gravels are almost always found reposing on schistose rocks, very rarely granitic or syenitic, as along the Pacific in North and South America. He further says that the gold in Quebec Province "whether in large or small grains, is generally so smooth, so much rounded and worn by friction, that it appears to come from some distance. . . . . The condition of the gold shows it to have been for the greater part, at least, detached, rounded and ground by erosive action of currents of water."

In the town of Ditton which borders on New Hampshire and is immediately north of the head waters of Indian stream, alluvial gold washing, by sluicing, has been carried on for several years. The place where the most extensive operations are, is on a branch of Salmon river, three and a half miles from the boundary. The stream at first runs a little south of east, but at the point where the principal excavations have been made it turns and runs northward. So that here there is a basin in which the drift has accumulated to the depth of fifteen or twenty feet. The upper portion, which consists of a very coarse gravel and has a thickness of three or four feet, was probably deposited by the stream and it contains no gold. The portion below consists of both coarser and finer material, from clay to boulders eight or ten inches in diameter. Through this the gold is irregularly distributed but it is most abundant near the bed rock, which here consists of an argillaceous schist, quite fissile and contains numerous cavities filled with a yellowish powder. This mine has been wrought during the summer months every year since 1866, and from ten to twenty men have been employed by the proprietor, J. H. Pope, M. P.

As gold was found immediately north of New Hampshire and since the drift through which it was distributed came from the northward, the drift striæ where they were noticed being S. 28 E. there is every probability that gold will be found within our limits.

But prospecting in a wilderness ten or fifteen miles from the habitations of men, where the places can be reached only on foot, requires a great amount of time and labor, and therefore our explorations have not been so thorough as they might have been under more favorable circumstances.

In my explorations on Indian Stream I employed an Indian, Mr. A. A. Annance, who was formerly a student at Hanover, but who now prefers hunting moose and trapping sable to studying calculus and reading Greek. The points examined were on and near Indian Stream about three and a half miles from the boundary. The stream here is quite rapid, and on either side the hills rise three and four hundred feet above its bed, while every few rods, either from the east or west, it receives a tributary. The rocks here, as elsewhere on Indian Stream, consist of argillaceous schists. These are often so wrinkled and corrugated that it is difficult to determine the dip, while elsewhere, especially where the rock is of a coarser texture, the flextures and contortions are not seen. In every respect the rocks are similar to those of Ditton. Immediately on Indian Stream the gold is chiefly found in the fissures of the schist, which is here so fragile that it is easily broken up by picks. A quarter of a mile from the stream we found the characteristic drift of this section. It consists of a bluish clayey gravel and contains boulders of schistose rocks, and it has a depth, where we excavated, of three and four feet. The gold seems to be distributed through the entire mass, though it is nowhere very abundant, yet when the road, that was several years ago projected from Connecticut Lake to the boundary, is constructed, this section will be well worthy of a thorough exploration especially as the streams are rapid and the descent of the bed rock is sufficient to carry away the loosened sand if the hydraulic process is used. It has been estimated that *"earth which contains only the twenty-fifth part of a grain of gold, or about two mills' worth in a bushel, will pay about two dollars a day to a pipe."—*J. H. Huntington.*

OTHER WORK.

I can only refer briefly to labors in other portions of the state. Early in the season explorations were carried on by myself in Cheshire and Hillsborough counties. On the seventeenth of June, with the assistance of eleven gentlemen from the graduating class at Dartmouth College, the exploration of the Pemigewasset country was commenced, and continued uninterruptedly for a month. These gentlemen kindly proffered their services without charge, and deserve the thanks of the community for their exertions in our behalf. Some have imagined the party as enjoying the lúxuries of the season in the cushioned seats of the well-appointed hotels about the mountains, with every want eagerly anticipated by dutiful attendants. On the contrary our houses were hastily extemporized sheds, our beds a few boughs or ferns placed upon boards, our food consisted of stale crackers and preserved meats, save a rare taste of trout and berries gathered in climbing mountains, and the luxury of an occasional basket of provisions sent by kind friends at the Profile House, and we were our own servants. The party consisted of A. A. Abbott, M. O. Adams, A. M. Bacheler, R. M. Carleton, C. H. Conant, G. E. Davis, H. C. Harrison, C. W. Hoitt, Jonathan Smith, W. Upham, A. W. Waters. All these gentlemen contributed something towards the accumulation of facts bearing upon the important questions discussed in the first part of the report. Messrs. Conant and Smith were so fortunate as to discover a new lake on the northwest side of Haystack Mountain, which has been christened Haystack Lake. It is parallelogramic in shape, fifteen rods long and half as wide, with rather shallow water, forming the headwaters of Gale River, three thousand seven hundred and eighty-seven feet above tide water as determined by the Aneroid barometer. Messrs Abbott and Bacheler succeeded in discovering a second lake still larger, upon the east side of Mount Kinsman, named as the other, after the mountain. Others of the party measured the length of the profile of the "Old Man of the Mountains," finding it to be thirty-six feet from chin to top of the head, the face itself being twelve hundred feet above the lake beneath. Soon after the disbanding of the first, a new party was formed, consisting of A. A. Abbot, W. Flint and W. Upham, with the aid of E. C. Atwood for a short period. This second party remained, some of them two months longer, exploring the country as far south as Sandwich.

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*Mining Statistics west of the Rocky Mountains 1870, p. 478.

I was also able to explore the shores and islands of Lake Winnipisseogee, besides making a reconnoissance of the whole country east of the lake as far as the state limits to the east and Jackson to the north. In September and October, in company with L. Holbrook, Jr., an attempt was made to trace out two bands of white quartzite in Hillsborough, Merrimack and Strafford counties. Their importance in subdividing the gneiss was first pointed out by Hon. S. N. Bell of Manchester, who has interested himself much in following their outcrops through the country. The result of all our examination has been that these two bands of quartzite have been followed, often in a serpentine course parallel to each other, eight or ten miles apart, from Temple to the north part of Strafford on one line, and from New Ipswich to the south part of Strafford on the other. Beyond this point the formations seem to be covered by the andalusite schists. After passing a wide band of gneiss to the west of the Temple-Strafford range, we come to a belt of porphyritic gneiss, which, in accordance with the view first suggested by Mr. Bell, seems to be the oldest formation in the state. Now if this view of the relative ages of the formation is correct, then we ought to find similar rocks south from the central and older porphyritic gneiss. Our observations indicate a perfect correspondence; for the studies commenced by G. A. Wheelock, Esq., in Keene, have brought to light the two beds of the same quartzites in Keene and Surry separated by a wide band of gneiss from the central group. As the same rock appears in Grafton and Newport fifty or sixty miles farther north it is likely the same arrangement continues past the centre of the state, while the descriptions of my father in the Final Report on the Geology of Massachusetts speak of a white quartzite having the same relations, midway through that commonwealth. Neither this nor the band of porphyritic gneiss mentioned as passing nearly north and south from New Hampshire to Connecticut on the meridian of Ware were represented upon his map, as their importance was not appreciated; but we may presume that their proper delineation and connection with the White Mountain rocks will solve the long vexed problem of New England Geology.

Other explorations were made — as a careful study of the strata about Claremont with reference to the possibility of supplying the citizens with water from an artesian well, a successful search for the syenites and breccias of the Norian system upon Mounts Belknap and Gunstock, and a trip to the molybdenite vein in Westmoreland and the iron ore of Piermont by Mr. Holbrook, who kindly wrote out full reports concerning their facies and value.

MUSEUMS AND MODELS.

The work of collecting specimens of the rock and minerals has also been prosecuted. Three of the sections across the state have also been measured during the past year, and samples to illustrate them been gathered and arranged upon the shelves at Hanover. The authorities of the College have increased their facilities for the exhibition of the result of the survey. I have a large number of boxes containing a portion of the collection designed for the State House packed and directed to you at the office of the survey, awaiting your orders. As you may remember, three topographical models prepared under our supervision have already been sent to you. The first is a delineation of the Mount Washington range of mountains upon the scale of one hundred and forty rods to the inch horizontally and one thousand feet to the inch vertically. The second shows the mountains of Bethlehem and Franconia upon a larger scale, and was originally prepared with a view to illustrate the theory of Professor Agassiz concerning the northward transportation of boulders by a local glacier from Lafayette and Profile Mountains. The third is the production of Mr. J. H. Huntington, and shows in relief nearly the whole of Coos county, upon the horizontal scale of one mile to the inch horizontally and one thousand feet to the inch vertically. It is our purpose to represent the whole of the state upon the same scale as the last, and we have the foundations already laid for this model in Culver Hall.

MICROSCOPY AND CHEMISTRY.

Professor Edwards has attended to the preparation of sections of our rocks for examination under the microscope and to the study of the diatomaceous earths as carefully as his other engagements have permitted. The draft of the introduction to this report has been submitted to me. Our chemist, Prof. Charles A. Seeley, has made numerous analyses whenever requested, and some of his results have been submitted. We have contributions also from E. S. Dana and B. F. Blanpied.

MOUNT WASHINGTON OBSERVATORY.

The United States government have continued their meteorological observations upon the summit of Mount Washington, since the date of my last report, and dispatches from there have been published daily in the leading newspapers all over the country. Last year I presented full meteorological tables from the time of the establishment of the observatory till we delivered it over to the Signal Service of the War Department. For the pleasure of those interested in the results I give herewith a condensed summary of the barometrical and thermometrical observations taken upon the mountain between August 1871 and April 1872, compared with those taken at the same time under the direction of Professor Young of Hanover:

DATE.	Barometer reduced to freezing point, Mt. Washington.	Barometer reduced to freezing point, Hanover.	Thermometer, Mount Washington.	Thermometer, Hanover.
August, 1871 . .	23.886	. . . .	47.6	. . .
September, " . .	23.843	29.476	36.1	52.5
October, " . .	23.765	29.432	30.5	47.2
November, " . .	23.425	29.336	12.2	28.3
December, " . .	23.350	29.348	3.2	19.1
January, 1872 . .	23.309	29.309	4.5	17.6
February, " . .	23.356	29.315	6.2	15.7
March, " . .	23.248	29.291	—1.4	18.8

ACKNOWLEDGMENTS.

Our special thanks for favors received during the past year are due to the following gentlemen and many others: His Excellency, J. A. Weston, Governor of the state; Hon. S. N. Bell, Manchester; J. J. Bell of Exeter; the trustees of the New Hampshire College of Agriculture and the Mechanic Arts; John F. Anderson, Portland, Me.; F. Willis Pratt, Engineer of the Eastern R. R.; Dr. T. Sterry Hunt, F. R. S, of Montreal, P. Q.; Prof. H. F. Walling, Boston; E. S. Coe, Bangor, Me.; S. Aug. Nelson, Georgetown, Mass.; Prentiss Dow, Claremont; Wm. C. Fox, Wolfeborough; Messrs. Taft, Greenleaf and Andrews of the Profile House, Franconia; F. G. Sanborn, Boston; C. P. Whitney, of Milford; Emmons Raymond, Lyndonville, Vt.; Gyles Merrill, St. Albans, Vt.; J. A. Dodge, Plymouth; George Stark, Nashua; H. G. Chamberlain, Concord; R. Stewart, Keene; Hon. Onslow Stearns, Concord; C. J. Brydges, Montreal, P. Q.; Henry Bailey and T. H. Cooper of the G. T. R.; J. K. Cole, Berlin Falls; L. P. Adley, Milan; E. Hicky, Stark; J. B. Melcher, Groveton; Dr. G. O.

Rogers, C. C. Brooks and F. Richardson, Lancaster: Geo. N. Merrill, Jackson; Geo. W. M. Pitman, Bartlett; Joshua Chapman, Thornton.

Respectfully submitted.

C. H. HITCHCOCK.

HANOVER, N. H., June 1, 1872.

REPORT

OF THE

GEOLOGICAL SURVEY

OF THE

STATE OF NEW HAMPSHIRE,

SHOWING ITS PROGRESS

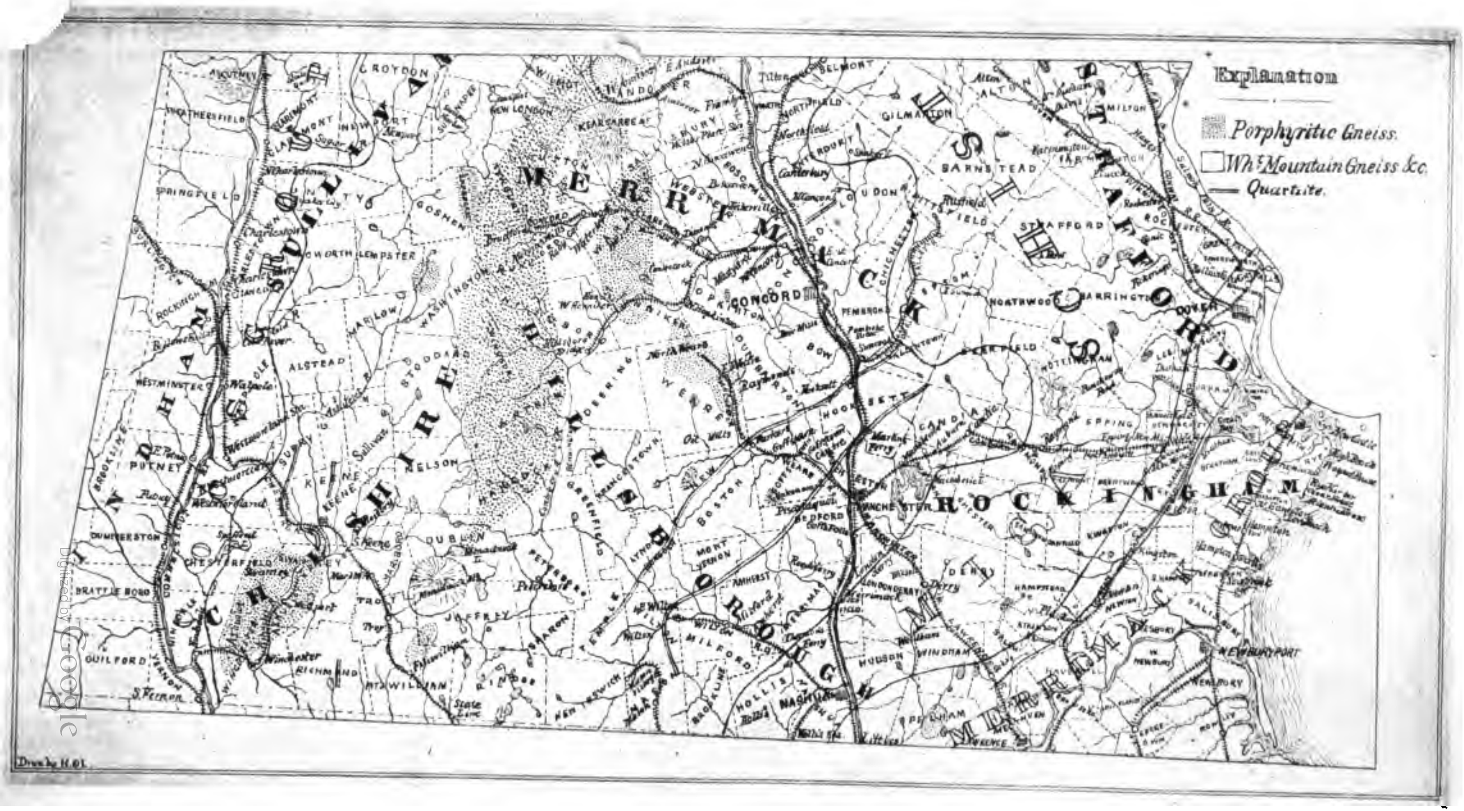
DURING THE YEAR 1872.

BY

C. H. HITCHCOCK, PH. D.

STATE GEOLOGIST AND HALL PROFESSOR OF GEOLOGY AND MINERALOGY
IN DARTMOUTH COLLEGE.

NASHUA:
ORREN C. MOORE, STATE PRINTER.
1873.


Explanation
Porphyritic Gneiss.
Wh. Mountain Gneiss &c.
Quartzite.
SULLIVAN
MERRIMACK
STRAFFORD
CHESHIRE
HILLSBOROUGH
ROCKINGHAM
WINDHAM
MERRIMACK
CROYDON
NEW LONDON
KEARSARGE
ANDOVER
BELMONT
GILMANTON
ALTON
MILTON
BARNSTEAD
STRAFFORD
NORTHWOOD
BARRINGTON
DOVER
NOTTINGHAM
CONCORD
PEMBROKE
BOW
HOOKSETT
CANDIA
EPPING
MANCHESTER
BEDFORD
DERRY
LONDONDERRY
AMHERST
MILFORD
HOLLIS
NASHUA
HUDSON
WINDHAM
PELHAM
METHUEN
NEWBURYPORT
NEWBURY
SALISBURY
KINGSTON
HAMPSTEAD
NEWTON
BOSTON
WEARE
DEERING
GREENFIELD
FRANCESTOWN
LYNDEBOROUGH
MONT VERNON
NEW IPSWICH
TEMPLE
SHARON
PETERBORO
JAFFREY
RINDGE
FITZWILLIAM
RICHMOND
TROY
DUBLIN
HARRISVILLE
NELSON
KEENE
SURRY
ALSTEAD
STODDARD
MARLOW
WASHINGTON
GOSHEN
LEMPSTER
UNITY
SPRINGFIELD
CLAREMONT
NEWPORT
CHARLESTOWN
WALPOLE
WESTMINSTER
PUTNEY
DUMMERSTON
BRATTLEBORO
CHESTERFIELD
WINCHESTER
GUILFORD
VERNON
BROOKLINE
ROCKINGHAM
WEATHERSFIELD
State Line
Drawn by H. O.

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1873.

REPORT.

Hon. B. F. Prescott, *Secretary of State:*

Respected Sir: — I have the honor to present you herewith the report of the operations of the Geological Survey, during the year ending June 1, 1873.

As during the previous years of labor, work has been commenced in the field as soon as the weather permitted, and continued till the falling snows of winter prevented any further explorations. Our efforts have been directed towards the completion of our investigations in the northern part of the State, and with so much success that I hope to be able to present to you, next month, the first volume of the final results of our labors. Inasmuch as the discoveries of the past year are to be fully treated of in this volume, it seems unnecessary to present in this report anything that will appear in that, and therefore I will state what we propose for the subject-matter of this book.

After considering the proper size of the volume, I have concluded to recommend that adopted by the Geological Survey of Vermont for a similar purpose. It is a quarto of the same dimensions with the "Smithsonian Contributions to Knowledge," or nine by twelve inches measured on the outside, and nine by six and one-half of type matter. A smaller size was at first thought preferable, the same with that used by the States of California, Wisconsin, Iowa and Illinois. In the last-named case, the maps and some other illustrations would need to appear in atlas form. This course might be desirable if both of our volumes were ready. It is less convenient than to have all the illustrations in the same cover with the text, and hence it seems preferable to recommend the larger form without an atlas, but bind the maps, sections, and other illustrations with the printed pages.

In connection with the subject-matter, the needful plates are mentioned. Among them there should be a large number of photographs illustrative of the scenery. Very few districts in our country display the opportunity in this regard offered by New Hampshire. Care has been taken to select those views which illustrate geological features, or those which are needed in the proper description of the formations. They should be not less than twenty-five in number. Most of them may occupy a whole page, while some are smaller, several upon a single plate. Photographic representations will prevent the necessity of using expensive wood cuts.

Inquiry among artists and publishers indicates that by the use of improved processes, the cost of photographic views can be reduced to more than one-half the expense of the cheapest prints taken in the old way. For example, one firm proposes to produce for us fifty thousand photographs, eight by five-and-one-half inches for $5,000, or for ten cents each; another firm, using the Heliotype process, offers to do the same work for $2,000, or for four cents each. The heliotypes lack the fire of photographs, but objects are copied just as perfectly. Those not acquainted with the subject, may not at first perceive the difference. No practical discovery has been made for many years, that will tend to cheapen the cost of illustration so much as the printing of photographs from negatives prepared with a coating of bichromate of gelatine. The negatives used by the sun-copying processes can be employed to produce heliotypes without injury, and that in indefinite numbers. It is very fortnnate for us that our publications have not been attempted earlier. Between photography and hand-sketching or engraving, there can be no comparison. One only need to compare the two cursorily to be satisfied of the great superiority of the former. The latter may attain the prominent idea requiring portrayal, but fails to reproduce the details.

Partly to show the value of this new method of preparing illustrations, I have presented with this report copies of a hastily drawn geological map of southern New Hampshire. Whatever imperfections may be seen in it are due to defects in the copy, not in the process of copying. Its value is seen better in illustrations of natural scenery.

All the plates we desire cannot be prepared in this way; some must be more expensive. With the presentation of the manuscript, I will endeavor to prepare a detailed estimate of their cost.

SUBJECT MATTER OF THE FIRST VOLUME.

I. Physical Geography. Under this head we shall discuss:

First, The character of the surface. The elevations and depressions, especially about the mountains, have been carefully studied and models have been made of the northern part of the State. We have also maps to show the contour lines for every five hundred feet all over the State, which might be presented. In connection with this topic we have prepared an extensive sketch showing the "History of the Explorations of the White Mountains" from the time of the first ascent of Mount Washington in 1642, by Darby Field, to the labors of our own survey.

Second, The history of the various topographical maps that have been made of the State may be presented, including a notice of the trigonometrical work now being carried on by Professor E. T. Quimby, under the direction of the United States Coast Survey.

Third, As the geographical distribution of certain trees and plants throws considerable light upon geology, we have prepared extensive catalogues of plants, maps of the limits of such trees as the hickory, chestnut, maple, beech, etc., which are of much value. It may not be desirable to give our catalogues entire, but rather the general conclusions derived from them.

Fourth, The geographical distribution of certain animals.

Fifth, Geology as related to scenery. The attractiveness of New Hampshire mountains, valleys and streams, brings crowds of summer visitors into the State from abroad, and the business of caring for them is next in importance perhaps to that of agriculture and manufactures, if we include transportation under the same general head. It seems important, therefore, for us to discuss subjects that affect favorably the income of a large class of our population.

Sixth, The physical character of New Hampshire has so intimate a connection with the climate, that it would be unpardonable to omit a chapter upon the climatology.

Seventh, By invitation Professor Quimby will present a sketch descriptive of extensive original researches in magnetography — facts relative to terrestrial magnetism, variation of the needle, etc.

In connection with these descriptions the following plates will be needful:

1. Map of the State, showing contour lines for every five hundred feet of altitude. This will exhibit the distribution of the mountain ranges.
2. Map showing the range of certain trees.
3. Map showing the range of certain animals.
4. Plates illustrative of geology and scenery.
5. Climatological map.
6. Diagrams illustrating the variation of the needle.

II. STRATIGRAPHICAL GEOLOGY.

Introduction. Relations of the Geology of New Hampshire to that of the adjacent States.

1. *Description of the Schistose Rocks occupying the Hydrographic Basin of Connecticut River.* This region was first explored, and is worthy of the earliest publication on account of its superior agricultural character and valuable minerals. Agricultural statistics prove the soils to be more productive in the valley than elsewhere in the State, and the returns of the United States as to population are more favorable to this district than to any other portion, save the cities. Its superior physical character shows why we have thought it proper to commence our work in Coos and Grafton counties. The formations belong to three general divisions.

(1) *Huronian.* This is the Quebec group of the early reports. The lower portion consists of greenish hydro-mica and talcose schists, conglomerates and quartzites. The upper portion consists largely of a light-colored schist, mainly silica, often passing into conglomerates. A micaceous variety occupies the upper Ammonoosuc valley. This has heretofore been confounded with the schist of the Coos group. In the same part of the Huronian there may be associated a compound of chlorite and feldspar. The areas are chiefly two; the first north of Columbia widening northwards; the second south of Stratford, nearly interrupted at Haverhill, and extending south along the Connecticut river to Charlestown.

(2) *Cambrian.* Certain auriferous clay slates and the Coos group may now be referred to the Cambrian provisionally, though no fossils have yet been found in them. This clay slate occurs in numerous patches the whole distance from Crown Monument to Charlestown. That which lies in Lyman has been more completely examined than the others on account of valuable veins of

gold contained in it. These slates are believed to be allied to the auriferous slates of Nova Scotia, which resemble the Lingula Flags of Great Britain, according to R. A. C. Selwyn, the Director of the Geological Survey of Canada.

The Coos group consists of quartzites, staurolite schists, mica and argillaceous schists, calciferous mica schist, with some decomposing slates and interesting dikes. Recent observations indicate that the quartzite is occasionally found isolated from the Coos rocks and lying upon gneiss unconformably. It extends nearly continuously from Massachusetts to Canada.

(3) *Helderberg.* These consist of fossiliferous limestones in Littleton, with the accompanying slates. Similar slates are found both to the north and south.

The illustrations required for this portion are the following:

1. General geological map of northern New Hampshire as far south as Orford and Thornton, upon the scale of six miles to the inch.
2 Five of the General Sections crossing the State and specially illustrated by specimens and drawings in the Museum.
3. Special map of the Ammonoosuc Gold Field, on the scale of one mile to the inch.
4. Local sections, perhaps three plates.

2. *Description of the Gneissic and Granitic Rocks east of the Connecticut Valley Schistose Rocks.* Several areas naturally present themselves: (*a*) Granites north of the Grand Trunk Railway; (*b*) Labradorian area between Grand Trunk Railway and Jefferson; (*c*) White Mountain area; (*d*) Gneissic rocks between (*c*) and the Connecticut river schistose rocks.

As at present advised the following seems to be the proper order of succession of the formations in the second division, beginning at the bottom:

Laurentian.	Porphyritic gneiss and granite.
	Bethlehem and Berlin gneiss.
	White Mountain or Andalusite gneiss.
	Breccia of Franconia.
Pemigewasset Basin.	Common granite.
	Spotted granite.
	Four series of compact feldspar.
	Green granite and syenite.

The second group has been described as occupying originally a hydrographic basin, filled by liquid igneous rocks instead of water. The names of Norian and Labrador have been applied to it in previous reports. Its discovery and separation as a system of formations from the other rocks is regarded as a valuable contribution to science, and will therefore be fully treated of in the volume.

In this general area also are certain formations of the Coos group, viz: andalusite slate, clay slate, breccias of Mounts Mote and Kiarsarge, with some igneous masses.

The illustrations desired for this part of the volume are these:

1. Map of the White mountains upon the scale of two and one-half miles to the inch.
2. Map of the Labradorian area north of Jefferson on the same scale.
3. A few special sections.

III. DYNAMICAL GEOLOGY. The elevation of mountains and metamorphosis of rocks.

IV. APPLICATIONS OF THE MICROSCOPE TO THE STUDY OF GEOLOGY. This will embrace the study of rock sections and of the organisms contained in polishing powders. The text will be prepared by Professors A. M. Edwards and T. Egleston of New York. The illustrations desired are numerous and expensive. The estimates have not yet been handed in.

V. AGRICULTURAL GEOLOGY. This relates to the classification, origin, and areas of the different kinds of soils existing in New Hampshire, illustrated by a map.

MICROSCOPICAL DEPARTMENT.

The use of the microscope in analyzing rocks is becoming quite common in Europe, and improvements in its application are constantly discovered. Heretofore an accurate knowledge of rocks has necessitated many expensive chemical analyses. Each mineral component must be determined separately, and perchance each mineral species is composed of six simpler compounds. Their determination requires great care, patience and much time. After each mineral has been identified it has been about impossible to state the relative proportions of each; in fact it has rarely been attempted. But under the microscope each mineral can be determined at a glance, and the relative proportions can be readily calculated. The cost of grinding down small bits of rock for microscopic examination is not great. Hence we can now take up the study of lithology, or the mineral composition of crystalline rocks, with great care. Practically the determination will decide upon the merits of stones for building materials, or for exposure in locations where durability is required.

Prof. T. Egleston, of the School of Mines, Columbia College, New York, has undertaken to grind down one hundred samples of New Hampshire rocks, carefully selected, for microscopical examination. He has taken them to Europe and proposes to send back samples of plates, both colored and uncolored, which shall be exact copies of the originals. With them will be given estimates of the cost of preparation. These will be in hand by the first of June, so that we hope to be able to give the Legislature some idea of the number of plates that may easily be prepared from these specimens in season for the first volume of the report. In case a favorable reply is returned Professor Egleston will superintend the preparation of the microscopical plates for the report while he is in Europe the present summer. It is supposed the work can be done there more economically than in this country, as the processes are novel.

In the text accompanying the plates it is proposed to present a full sketch of the applications of the compound microscope to the study of Geology. The principles of the subject will be stated so that any persons familiar with this instrument may apply it to the examination of specimens in which they may be interested. We are not aware that micro-petrology has yet been extensively described in any American publication.

GEOLOGY OF SOUTHERN NEW HAMPSHIRE.

Among other matters examined the past year, attention has been paid to the age and distribution of the formations in the southern part of the State. The explorations had for their primary object the discovery of the geological place and distribution of the celebrated Concord granite.

The first requisite was to discover some kind of rock that could be easily followed through the country and not be confounded with anything else. When its course is known then one must discover how the valuable mineral is related to the constant element. Now, supposing that the relations of the two are invariable or vary in a fixed way, it is easy to find the desired mineral at the same uniform distance from the guide.

For example, as for this purpose beds of limestone or soapstone are commonly selected, let us suppose we have discovered the course of a bed of limestone for fifty miles through Merrimack county. This line of limestone is four hundred feet east of a bed of phosphate of lime in a known locality, and overlies it. Now, in order to find the phosphate five miles away, we need to measure a distance of four hundred feet west from the limestone, and the phosphate will be found in the same inferior position as before, if there has been no disturbance. The same measurements may be taken at convenient distances, till the entire length of both rocks has been found.

This is an imaginary case. In the lower counties there are bands of quartzite which may be employed practically, both in connection with the soapstone and granite. The rock is not likely to be confounded with anything else, and is persistent. It is also of service in classifying the formations. The importance of the investigation leads us to present the accompanying map, taken by the heliotype process as explained above, upon which the general outlines of the great rock groups are given, as now understood.

There seem to be the following groups between the Exeter sienites and the Coos group:

1. Porphyritic gneiss and granite.
2. Granitic gneiss.
3. White mountain series, including andalusite gneiss, ordinary and imperfect gneiss, the so-called granite of Concord and Fitzwilliam, beds of soapstone and limestone.
4. Bands of quartzite.
5. Mica schist.
6. Andalusite slates or outliers of the Coos group. Of these the map distinguishes the porphyritic group, the quartzite bands, the mica schist and the Coos outlier. The other gneiss, being yet known imperfectly, I will not attempt to divide.

Porphyritic Group. This consists mainly of gneiss full of large crystals of orthoclase feldspar, associated with ferruginous and other bands. It is regarded as the oldest of all the formations in the State for these reasons:

1. The principal range is flanked on both sides by similar varieties of gneiss, and later series of rocks in the same order. The newer groups being outermost, the anticlinal rather than the synclinal structure is suggested, and hence the greater antiquity of the central range.

2. This rock is apparently covered by the other members of the gneiss series in the northern part of the State.

3. The lithological chamber corresponds with that of known Laurentian strata in Canada, North Carolina, and elsewhere.

Granting the great age of this group, let us consider its distribution upon the map. There is first the main range from Dublin north through Hancock, Antrim, Stoddard, Windsor, Hillsborough, Washington, Bradford, Newbury, Sutton, New London, and so on to Waterville in Grafton county, where it is concealed by the Labrador rocks. Fragments of it may appear in Fitzwilliam, and it is said to extend across Massachusetts to Connecticut. On the west there is an oval area in Chesterfield, Swansey, and Winchester, of considerable size. It is possible that the area in West Washington and Lempster may be a part, of the main range, or extend to Sunapee mountain. There is a smalll area in Croydon, at the east base of Croydon mountain.

On the east, the boundaries of the Warner range are not clearly ascertained. It has been represented heretofore as joining the main range in Sutton. The Weare area may belong to a separate upheaval, connecting with the two small patches in Hopkinton and the one in New Boston. The small areas in Webster and East Concord are hardly worthy of notice. There are other patches in Pelham and Seabrook. A section from New Durham to Hanover would cross this rock six times. Our further explorations will probably enlarge these areas. Their repetition, assuming our premises correct, indicates so many anticlinals, the intervening schist being newer, and of different ages.

There is decided evidence of a range of very ancient gneiss from Mason to Deerfield. It abounds in feldspar, the strata are very highly inclined and remarkably plicated. It is very granitic, so much so that but a slight additional metamorphic action would be needed to obliterate all the planes of stratification. This formation is probably repeated west of the quartzite ranges, and also in Cheshire and Sullivan counties. The character of the strata and the superabundance of feldspar readily distinguishes it from everything else.

White Mountain Series. For reasons heretofore stated, this term is employed to designate the several rocks mentioned above. This series of strata probably occupy mostof the gneissic area of the map. Of the specific members, that known as "Concord granite" has been traced irregularly from Concord to Fitzwilliam. It will require more detailed examinations, such as we hope to make the present season, to enable us to say positively where this valuable band may be found. It seems to lie near the quartzite, say from a quarter to half a mile above it. Hence, if it exist as a range, it should be adjacent to all the quartzite bands, and its distribution can be determined readily in the manner suggested above. A section across these ranges near Manchester shows a similar granite inside both of them, while a protracted examination has failed to show the quartzite beyond the west part of Concord. This rock is not a proper granite. There is an arrangement of the particles of mica along parallel planes, which allows the rock to split readily. These we regard as strata. They are seen plainly in the inferior qualities of the stone, and farther south, the celebrated "granite" of Pelham and Monson, Mass., shows the strata perfectly. The latter appear to be identical with the Concord stone. Microscopic sections, when available for study, will add much to our knowledge of this variety of rock.

By scrutinizing the course of a band of rock closely packed with andalusite it appears probable that the valuable soapstone of Francestown is continuous into Weare, as well as extending further southwest. Outcrops have been found in four localities. The soapstone of Richmond resembles it also, and seems to be on the same course. Hon. M. A. Hodgdon of Weare has made an extensive excavation in this bed on Mount Misery, which throws considerable light on its character. The talc of the Francestown stone is arranged in clusters of crystals radiating from a centre, with scattered bits of magnetic pyrites. Their peculiar arrangement can be seen upon most of the stoves manufactured from it, and used so commonly. I have never seen soapstone from any other range at all like it. The immense number of the radiated balls, evenly distributed throughout, gives a uniform tenacity to the stone which makes it of such superior value for stoves, in spite of the pyrites present.

Precisely the same features appear in the stone of Mr. Hodgdon's quarry. Blocks of it are undistinguishable from that manufactured into stoves at Nashua. The pyrites are found in scattered particles and in small veins which can be thrown away, and there are other minerals associated with it. The quality and thickness of the Mount Misery stone have improved so much over what they were at the surface, that further excavations in the bed are warranted, as well as careful search along the line of strike for other outcrops.

Quartzites. Our map shows two nearly parallel ranges of quartzites; the one extending from Allenstown to Mason, and the other from the same town to Temple. Diligent search has failed to reveal any traces of these bands beyond Allenstown, which surely belong to them. Inasmuch as the accompanying gneisses also terminate, both those included between the ranges, and the crumpled granitic gneiss to the southeast, and the mica schists beyond seem to have taken a northerly course, we conclude that the continuation of all those strata is concealed by the underlying blanket of mica schist. The map shows how completely these bands are interrupted by the newer schists. Nothing has yet been suggested to account for the termination of the quartzite bands in Temple and Mason. Farther search may reveal them on the same line in Massachusetts.

The map shows these quartzites in Richmond, Keene, Surry and Grafton on the west side of the porphyritic range. We have not yet been able to trace them out in that part of the State. These ranges have been seen in Massachusetts, especially in New Salem. Their occurrence in two bands on both sides of the main anticlinal will furnish us the general clue to the stratigraphical structure of the gneiss, besides making plain the line of the granites and soapstone, for there is a range of the latter mineral accompanying the Keene quartzites. It will be observed that the latter curve around the older porphyritic rocks of Swanzey.

It is almost exciting to follow the hills of this rock through the towns. They can be seen miles away, being as white as snow. The following are the most notable hills along its course. In East Concord, Oak Hill; West Concord, Pine Hill; on the Temple range, the foundations of the upper railroad bridge; and the

Pinnacle in Hooksett; the hill of quartz quarried for the manufacture of glass in Lyndeborough, and a long ridge in Temple, extending northeasterly from the village; on the Mason range, a high hill northeast from East Wilton; the northeast corner of Amherst; and Campbell Hill in Hooksett. The ranges are 6.20 miles apart in New Boston and Bedford, narrowing to 3.12 in Hooksett and five miles in Wilton. The most remote localities in Temple and Mason are six and a half miles distant from each other. The Mason range does not curve to the west, as erroneously shown upon the map.

There are also ranges of quartzite in the mica schist group. The most extensive is in Raymond and Nottingham. Other outcrops are in Londonderry, Strafford and Pittsfield. Those in Strafford were formerly regarded at the extension of the Temple and Mason ranges.

Mica Schist. This formation covers a great area in Rockingham and Strafford counties. In general it is a simple compound of mica and quartz, resembling an argillaceous rock at times, and often showing the mica in irregular blotches. It everywhere contains beds of a very coarse granite. In the south part of Rockingham, in Barrington, Strafford, and elsewhere, the granite remains in ridges while the schist has decomposed, thus making one believe granite to be the prevailing rock of the country, without careful search for the schist in the valleys.

The Syenites of Exeter bound this group on the east. The Merrimack group seems to be distinct from it, though the two have been confounded together heretofore. This rock forms mountain masses in many towns. Such are the ridges between Hill's Corner and Shaker Village in Canterbury, the Pinnacle and Bean Hill in Northfield, Catamount Mount in Pittsfield, Brush Hill, McKays, Fort, and Nottingham mountains in Epsom, Saddleback Mount in Northwood, Devil's Den in Auburn, ridges in Farmington, etc.

Narrow patches of mica schist occur resting in synclinal form on the gneiss west of the Merrimack river, but it is of no use to attempt to represent them at present.

The above is a very meagre sketch of the geology of the southern part of the State, but we feel confident that it embodies the true theory of its stratigraphical structure. The development of the theory is only a matter of time — capable of accomplishment the present season, unless unexpected obstacles arise.

MR. HUNTINGTON'S LABORS.

Mr. Huntington has labored long and zealously the past season in the field and office. As his results belong entirely to the first volume, I would refer you to that for the report of what he has done.

CONCLUSION.

Some of the facts brought to light by us have been presented to the public the past year in communications to the American Association for the Advancement of Science at their Dubuque meeting, and to the Boston society of Natural History. Their substance will appear in the volume already spoken of.

Our special thanks for favors received during the past year are due to the following gentlemen, and many others — Hon. S. N. Bell, of Manchester; L. W. Palmer, of Lyndonville, Vt.; Gyles Merrill, of St. Albans, Vt.; J. H. Dodge, of Plymouth; George Stark, of Nashua; H. G. Chamberlain, of Concord; R. Stewart, of Keene; Hon. Onslow Stearns, of Concord; C. J. Brydges, Montreal, P. Q.; J. Prescott, Boston; Hon. M. A. Hodgdon, Weare; J. A. Leach, of Nashua; the following members of the class of 1872, Dartmouth College: E. J. Bartlett, W. H. Cotton, L. G. Farmer, G. H. Fletcher, A. M. French, G. M. French, W. H. Galbraith, W. A. Holman, E. D. Mason, C. H. Sawyer, H. M. Silver, G. F. Williams and T. W. D. Worthen; N. W. Ladd and A. O. Lawrence of the class of 1873.

Respectfully submitted.

C. H. HITCHCOCK.

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